A

SYSTEM OF ANATOMY

FOR THE USE OF

STUDENTS OF MEDICINE.

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FOURTH EDITION.

WITH NOTES AND ADDITIONS.

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PREFACE BY THE EDITOR.

The value of the present work having been sufficiently tested by its very diffused use in the profession, and by a third edition being now called for, the editor has been induced to superintend the latter, with a hope that its utility and the public conviction in its favour have been in no wise diminished. The closeness of the connexion between himself and its lamented author, furnished also another and a very powerful reason, why he should endeavour by such means as he commanded, to contribute to perpetuate the memory of a man whose literary and professional career had been so conducive to the reputation of his country, and whose philanthropy and suavity of manners had established him so firmly in the affections and confidence of all who knew him.

Several amendments have been introduced by the way of corrections, alterations and additions. The latter for the most part, appear between brackets and in the form of notes, but there are many which could not be marked in such manner without giving the text a garbled appearance, they therefore appear as portions of the original work.

The whole mass of matter introduced as amendments, is greater indeed, than a superficial perusal of the work would intimate; and the only way for the reader to arrive at it, will be by a careful comparison of the last with the present edition. The editor, however, has been careful not to allow the spirit of change or improvement to affect the work in any points excepts such as seemed to him absolutely to require it, and where he was fully warranted by the best authorities in Descriptive Anatomy. It would have been sufficiently easy for him to have extended the work considerably beyond its present dimensions; but from its having been originally designed as a text book for the course of Lectures on Anatomy in the University of Pennsylvania, and for the benefit of practitioners, who are always most assisted by condensed views on this subject, he was apprehensive of perverting or of frustrating its objects by such extension. In consequence of which he has principally confined himself to adding where additions were called for by the recent discoveries in Anatomy, and by the omissions of older ones.

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SYSTEM OF ANATOMY.

PART I.

OSTEOLOGY.

CHAPTER I.

OF THE STRUCTURE OF BONES—OF CARTILAGES—OF THE FORMATION OF BONE—OF THE TERMS USED IN DESCRIBING BONES.

SECTION I.

Of The Structure of Bones.

THE human bones, in a recent adult subject, are of a dull white colour; their texture is varied, not only in different parts of the skeleton, but in different places of the same bones. Thus, in long bones, the middle portion is compact with a cavity in the centre, the extremities are cellular or spongy, and the central cavities are occupied by a network formed of thin plates and fibres. In flat bones, the external surfaces are composed of firm plates, but the internal substance is cellular.

[The cellular structure of bones is attended with several important advantages. In the cylindrical bones it gives great additional strength, by increasing their diameter, without adding to their weight; and by swelling out their articular extremities, it produces much greater security of the joints, by obviating

the tendency to dislocation, and rendering their movements more steady. A simple experiment will satisfy any one that the increase of volume in the extremities of the long bones, is not attended with an increase of osseous matter; for in the dried bone, the section of an inch from the centre will weigh as much as the same length from the extremities, notwithstanding the greater size of the latter. Dr. Physick has pointed out another very important advantage of the cellular structure of bones, besides those of its making them nearly as strong as if they were solid, and at the same time diminishing what otherwise would have been a weight too oppressive for the muscular powers, He thinks that thereby the concussion of the brain, and of the other viscera is frequently prevented; and in nearly all cases diminished, in falls and in blows. He illustrates the position by showing, first, the concussion which takes place through a series of ivory balls suspended by threads; if one be drawn to some distance from the others, and allowed to impel them by falling. The momentum in this case impels the ball at the further end of the row, almost to the distance from which the first one fell. But if a ball of the same size, composed of the cellular structure of bone, be substituted for one of the ivory balls, and the experiment be repeated, the momentum of the first ball is lost almost entirely in the cellular structure of the substitute; particularly if the latter be well soaked previously in water, so as to give it a condition in point of moisture allied to the living state. Adopting this experiment as demonstrative of the fact, Dr. Physick asserts, that in falls from an eminence upon the feet, the percussion, by the time it has passed through the cellular structure of the foot, leg, thigh, vertebral column and the condyles of the occiput, is very much diminished in force, and carries much less impulse upon the brain. Again, in blows on the head,

the brain, though much protected from external injury by the arched form of the cranium, has an additional security from the interposition of the diploë, which weakens the force of the blow.

In all the bones there are canals, independent of the cellular structure, which penetrate to a greater or less extent between the lamina, and go in various directions, some longitudinal, others oblique and transverse. These canals transmit the blood vessels, and were first pointed out with exactitude by Clopton Havers, an English anatomist. But he assigned a wrong application to them, as he believed that the marrow ran through them, in order to make the bones supple, and to unite their lamina more strongly. S. B. Albinus corrected the mistake, by demonstrating that they were filled with blood vessels. These canals in a vertebra are particularly large, and open on the posterior face of its body, by one or two large foramina. In the cranium they are remarkably well seen; but their discovery is of more modern date. M. Portal says, that in the bones each kind of vessel has a particular canal for itself alone; those of the arteries are therefore to be readily distinguished from such as belong to the veins and to the nerves; and this takes place both in the large and in the small canals. Occasionally the vessels dip into a common canal, but if any one will take the trouble to follow them, he will find them ultimately separating from each other.]

A fibrous structure is very obvious in the bones of young subjects, and in some bones which have been slightly calcined.

A lamellated structure may also be demonstrated in many bones.

In the firmness of their texture and their general aspect, bones resemble inorganic matter, but there are the strongest proofs of their organization.

For example, if a bone be macerated in certain

acid liquors, the earthy matter will be dissolved, and a membranous or cartilaginous substance will remain, resembling the bone in form and size.*

If the bones of a young subject, after being injected, be treated in the same way, this membranous substance will appear to be very vascular—when the injection has been successful, it will appear uniformly reddened by the great number of vessels which are filled with the matter of injection. These vessels discharge blood when the periosteum is removed from the surface of bones, in the living subject, and they also form granulations upon bony surfaces that have been thus denuded.

The existence of absorbent vessels, and even of nerves, in bones, is equally certain with that of the blood vessels, but they are not easily demonstrated. [The French anatomists have occasionally traced branches of the fifth pair of nerves going along with the nutritious arteries into some of the bones; but as yet no other nerves have been seen by them. Mr. Portal speaks in familiar terms of the existence of both nerves and lymphatics in the bones, as if he had often noticed them; he, however, has omitted to inform us of the source, from which the former come.] In a sound state bones have no sensibility, but pain is often felt in them when diseased.

Modern chemistry has ascertained that the earthy matter of bones is principally a phosphate of lime; carbonate of lime, in a smaller quantity, is also found in them. These earthy substances compose near one-half of the weight of bones, and a large proportion of the remainder appears to be gelatinous and cartilaginous matter.

Bones are invested with a firm membrane denomi-

* One part of muriatic acid to thirty of water is a good mixture for this purpose, by taking care to keep up the strength of the mixture, by additions of the acid from time to time.—Ed.

nated *periosteum*, which is of a fibrous texture, and in some places may be separated into different lamina. The external surface of periosteum is connected with the contiguous parts by cellular membrane, the internal surface is connected with the bone by a great number of fibres and of blood vessels. The orifices of these vessels appear when the periosteum is separated from bones in the living subject.

This membrane covers the whole bony surface, except those parts which are invested by cartilages, and the capsular ligaments of joints; those which are occupied by the insertion of tendons and ligaments, and the bodies of the teeth. It appears most intimately connected with the surfaces of spongy bones, and the extremities of the long bones. In a sound state it has very little sensibility; but in some cases of disease it appears to be very sensible: of course it must be supplied with nerves, although several expert anatomists have declared they could not trace them.

It is probable that the principle use of the periosteum is to transmit vessels to the bones for their nourishment; but death, or exfoliation of the surface, does not always take place when the periosteum is removed from a portion of bone.*

At the extremities of the long bones, the foramina for the transmission of blood vessels and fibres are much larger than they are in the middle; but there is an oblique canal near the middle of these bones, which transmit vessels to the internal membrane.

The surface of the internal cavities and cells of bones is lined by a membrane, more delicate and more vascular than the periosteum, which contains

* Dr. Physick thinks that the periosteum frequently prevents the bones from participating in contiguous disease, as the pleura turns off an abcess in the parietes of the thorax from its cavity, or the peritoneum from the cavity of the abdomen.—Ed.

the medullary matter that is always found in their cavities. [This is the internal periosteum or the medullary membrane of the bones. Mr. Portal denies that it exists as a distinct membranous sac, but asserts, that it is derived from the envelope of the vessels which is sent in along with them from the periosteum.]

It has been said that in some circumstances this membrane has had great sensibility, but the reverse is the case in common.

The medullary matter in the large cavities of bones has a strong resemblance to adeps. That which is in the cells at the ends of the long bones appears more fluid. In young animals it is slightly tinged with a red colour.

SECTION II.

Of Cartilages and their Structure.

Cartilages are white elastic substances, much softer than bones, in consequence of a smaller quantity of earth entering into their composition.

Their structure is not so evidently fibrous as that of bones; yet by long maceration, or by tearing them asunder, a fibrous disposition is perceptible.

In articular cartilages their fibres are parallel to each other, and directed towards the cavities of the respective joints.

Their vessels are extremely small, though they can be readily injected in cartilages where bone is beginning to form. The vessels of the cartilages of the joints, however, seem entirely to exclude the red blood; no anatomist having yet been able to inject them. They have no cancelli, nor internal membranes, for lodging marrow; no nerves can be traced into them; nor do they possess any sensibility in the sound state.

Upon their surface, there is a thin membrane termed perichondrium, which in cartilages supplying the place of bone, as in those of the ribs or at the ends of the long bones in children, is a continuation of the periosteum, and serves the same general purposes to cartilage as this does to bone.

Upon the surface of articular cartilages, the perichondrium is a reflection of the inner surface of the capsular ligament, and is so very thin, and adheres so closely, as to appear like part of the cartilage itself.

One set of cartilages supplies the place of bone, and by their flexibility admit of a certain degree of motion, while their elasticity recovers their natural position, as in the nose, larynx, cartilages of the ribs, &c.

Another set, in children, supplies the place of bone, until bone can be formed, and affords a nidus for the osseous fibres to shoot in, as in the long bones of children.

A third set, and that the most extensive, by the smoothness and lubrication of their surface, allow the bones to move readily, without any abrasion, as in the cartilages of the joints.

A fourth set supplies the office both of cartilage and ligament, giving the elasticity of the former and the flexibility of the latter, as in the bones of the spine and pelvis.

SECTION III.

Of the Formation of Bone.

The generality of bones, and particularly those which are long, are originally formed in cartilage; some, as those of the skull, are formed between membranes, and the teeth in distinct bags.

When ossification is about to begin in a particular

part of a cartilage, most frequently in the centre, the arteries, which were formerly transparent, become dilated and receive the red blood from which the osseous matter is secreted. This matter retains, for some time, the form of the vessels which give it origin, till more arteries being by degrees dilated, and more osseous matter deposited, the bone at length attains its complete form.

During the progress of ossification, the surrounding cartilage by degrees disappears; not by being changed into bone, but by an absorption of its parts, the new-formed bone occupying its place.

The ossification of broad bones, as those of the head, begins by one or more points, from which the osseous fibres issue in rays.

The ossification of long bones, as in those of the extremities, begins by central rings, from which the fibres extend towards the ends of the bones.

The ossification of spheri-formed bones begins by one nucleus, as in the wrist; and that of irregular shaped bones by different nuclei, as in the vertebræ.

Some bones are completely formed at the time of birth, as the small bones of the ear.

The generality of bones are incomplete until the age of puberty, or between the fifteenth and twentieth year, and in some few instances until a later period.

In children, many parts of bones, particularly the ends of long bones, are distinct from the bodies; they are called epiphyses, and can be readily separated from the bodies of bones by boiling, or by maceration in water.

The epiphyses begin to appear after the body of the bone is ossified, and are themselves ossified at seven or eight years of age, though their external surface is still somewhat cartilaginous.

They are joined to the body of the bone by cartilages, which are thick in children, but gradually

become thinner as ossification advances, till at last, in the adult, the external marks of division are not to be seen, though frequently some mark of distinction may be observed in the cancelli.

SECTION IV.

Of the Terms used in the Description of Bones and their Articulations.

The study of this subject has been rendered more difficult by the unnecessary introduction of many hard words, but some of these words are so generally used, that they ought to be understood by the student of anatomy.

The word *process* signifies any protuberance or eminence arising from a bone.

Particular processes receive names from their supposed resemblance to certain objects; and their names are very often composed of two Greek words; thus the term *coracoid*, which is applied to a well known process, is derived from the Greek words κοραξ, a crow, and ειδος, resemblance.

If a process has a spherical form it is called a *head*. If the head is flattened on the sides, it is denominated a *condyle*.

A rough protuberance is called a *tuberosity*. A ridge on the surface of a bone is called a *spine*.

The term *apophysis* is nearly synonymous with process. It signifies a protuberance that has grown out of the bone, and is used in opposition to the term *epiphysis*, which signifies a portion of bone growing upon another, but distinct and separable from it; as is the case in infancy with the extremities of the long bones.

The cavities on the surfaces of bones are named in the same way, as will appear by a reference to the glossary at the end of this work.

Words of this kind have been used most profusely in the descriptions of articulations, and here also their utility is doubtful. Therefore, for many terms used on this occasion, the reader is referred to the glossary: but the following are necessary to be understood.

Symphysis does not merely imply the concretion of bones originally separate, as its derivation imports; but it is understood also to mean the connexion of bones by intermediate substances. Thus there are three species of symphysis, particularly noticed, viz.

Synchondrosis, when bones are connected to each other by cartilage; as the ribs and sternum.

Synneurosis, when they are connected by ligaments, as in the moveable articulations.

Syssarcosis, when they are connected by muscle.

The different articulations are of two kinds, viz. *Synarthrosis* and *Diarthrosis*.

Synarthrosis is the name of that kind of articulation which does not admit of motion. There are three species of synarthrosis, viz.

Suture, when the indented edges of the two bones are received into each other, as is the case with the bones of the cranium.

Gomphosis, when one bone is fixed in another like a nail in a board, as the teeth in their sockets.

Shindylesis, when the thin edge of one bone is received into a narrow furrow of another, as the nasal plate of the ethmoid in the vomer.

Diarthrosis is the name of that kind of articulation which admits of motion. Of these articulations there are three species, viz.

Enarthrosis, when a large head is received in a deep cavity, as the head of the thigh bone in the acetabulum.

Arthrodia, when a head is connected with a superficial cavity.

Ginglimus, when the extremities of bones apply to each other so as to form a hinge.

But most of the important joints have so many peculiarities that they cannot be understood without studying them separately. It may therefore be doubted whether the classification and arrangement of joints is any way necessary.

CHAPTER II.

OF THE SKELETON AND ITS DIFFERENT PARTS, AND THE INDIVIDUAL BONES OF WHICH THEY ARE COMPOSED.

The bones of an animal arranged and connected to each other in their natural order, separate from the soft parts, compose a skeleton.

The skeleton is said to be natural when the bones are connected by their own ligaments, which have been allowed to remain for that purpose.

It is called artificial, when the bones are connected with wire, or any foreign substance.

The artificial skeleton is best calculated for studying the motions of the different bones, because the dry and hard ligaments of the natural skeleton do not allow the bones to move; but the bones of young animals do not admit of the preparation necessary for an artificial skeleton, as their epiphyses would separate, and they are therefore formed into natural skeletons.

The study of the skeleton and its mechanical properties, as a piece of machinery, is absolutely necessary to a perfect understanding of many motions of the body, and of the action and co-operation of muscles; but any observations on this subject will be better understood after the individual bones and the muscles have been described.

The *skeleton* is divided into the *head*, the *trunk*, the *superior* and the *inferior extremities*.

SECTION I.

Of the Head.

The head comprehends the Skull, or Cranium, and Face.

The *cranium* consists of eight distinct bones, which, when placed in their natural order, form a large spheroidal cavity for containing the brain, with many foramina or apertures that communicate with it.

These bones are of a flattened form. They are composed of two lamina or plates called tables, with a cellular structure between them, called meditullium, or diploë. The external table is more firm and thick than the internal. The latter is comparatively very brittle, whence it is called the vitreous table. [Between the two tables which compose the flat bones of the cranium and running through the diploë, are several sinuses, which are occupied by veins in the recent subject. They were discovered by M. Fleury about twenty years ago, while he was Prosector at the school of Medicine in Paris, and engaged in some inquiries relative to the structure of the cranium at the instigation of M. Chaussier. The account which M. Chaussier gives of these veins is as follows: they are situated in the middle of the diploe between the two tables of the skull, and like all other veins are intended to return the blood to the heart. They are furnished with small valves, have extremely thin and delicate parietes, and commence by capillary ramifications coming from the different points of the vascular membrane which lines the cells of the diploë. Their roots are at first extremely fine and numerous, form by their frequent anastomoses a kind of network, and produce by their successive junction, ramuscles, branches, and large trunks, which, becoming still more voluminous, are directed towards the base of the cranium. Some varieties exist in regard to the number, size, and disposition of these trunks, but generally one or two of them are found in each side of the frontal bone, two in the parietal bone, and one in each side of the occipital bone. Anastomoses exist between these seve-

ral trunks by which the veins in the parietal bone are joined to those in the frontal and in the occipital. Branches from the right side of the head also anastomose with some from the left side. Besides the branches already mentioned, one or two smaller than the others are directed towards the top of the head and terminate in the longitudinal sinus.

The descending veins of the diploë communicate in their passage with the contiguous superficial veins, and empty into them the blood which they receive from the several points of the diploë. These communications are produced through small foramina which penetrate from the surface of the bone to the diploë. The trunks of such diploic veins as are continued to the base of the cranium, open partly into the sinuses of the dura mater, and partly into the venous plexus at the base of the pterygoid apophyses, and form there the venous communications called the emissaries of Santorini. Moreover there are communications sent from the diploic veins through the porosities of the internal table of the skull to the veins of the dura mater. This fact is rendered very evident by tearing off the skull cap, when the surface of the dura mater will be studded with dots of blood, and the internal face of the bone also, particularly in apoplectic subjects. It appears indeed that the arteries of the cranium are principally distributed on its external surface and the veins on its internal surface and diploë.

In the infant the diploic veins are small, straight, and have but few branches: in the adult they correspond with the description just given; and in old age they are still more considerable, forming nodes and seeming varicose. In children, when the bones are diseased, they partake of the latter character. In order to see them fully, the external table of the skull

must be removed with the chisel and mallet, both from its vault and base.]

The *periosteum*, which is on their external surface is called *pericranium.* Internally, the *dura mater* or membrane which covers the brain, supplies the place of periosteum.

There are eight of these bones, which are thus denominated: *Os Frontis*, *Ossa Parietalia*, *Ossa Temporum*, *Os Occipitis*, *Os Sphenoides*, and *Os Ethmoides.* The two last are called common bones, to denote that they are connected with the bones of the face as well as with those of the cranium.

The os frontis forms the whole fore part of the vault of the cranium: the two ossa parietalia form the upper and middle part of it; the ossa temporum compose the lower part of the sides; the os occipitis makes the whole hinder part and some of the base; the os ethmoides is placed between the orbits of the eyes, and the sphenoides extends across the base of the cranium.

The Sutures.

THE above bones are joined to each other by five sutures; the names of which are the *Coronal*, *Lambdoidal*, *Sagittal*, and two *Squamous.*

The *coronal suture* is extended over the head, from within about an inch of the external angle of one eye, to the like distance from the other; which being near the place where the ancients wore their garlands, this suture has hence got its name. Though the indentations of this suture are conspicuous in its upper part, yet an inch or more of its end on each side has none, but is squamous and smooth.

The *lambdoidal suture* begins some way below, and farther back than the vertex or crown of the head, whence its two legs are stretched obliquely downwards, and to each side, in form of the Greek

letter Λ and are now generally said to extend themselves to the base of the skull: but formerly, anatomists reckoned the proper lambdoidal suture to terminate at the squamous sutures: and the portion continued from them on each side, where the indentations are less conspicuous than in the upper part of the suture, they called additamentum suturæ lambdoidis.

This suture is sometimes very irregular, being made up of a great many small sutures, which surround a number of insulated bones, that are generally more conspicuous on the external surface of the skull than internally. These bones are commonly called triquetra or wormiana; their formation is owing to a greater than ordinary number of points of ossification in the skull, or to the ordinary bones of the cranium not extending their ossification far enough, or soon enough; in which case, the unossified interstice between such bones begins a separate ossification, in one or more points; from which the ossification is extended to form as many distinct bones as there were points which are extended into the large ordinary bones, and into each other.

The *sagittal suture* is placed longitudinally, in the middle of the upper part of the skull, and commonly terminates at the middle of the coronal and of the lambdoidal sutures; between which it is said to be placed, as an arrow is between the string and the bow. This suture is sometimes continued through the middle of the os frontis down to the root of the nose.

The *squamous agglutinations*, or false sutures, are one on each side, a little above the ear, of a semicircular figure formed by the overlapping (like one scale upon another) of the upper part of the temporal bones on the lower part of the parietal, where, in both bones, there are a great many small risings, and fur-

rows, which are indented into each other; though these inequalities do not appear till the bones are separated. In some skulls, indeed, the indentations here are as conspicuous externally as in other sutures; and what is commonly called the posterior part of this squamous suture, always has the evident serrated form; and therefore is reckoned by some a distinct suture, under the name of additamentum posterius suturæ squamosæ.

The *squamous suture* is not confined to the conjunction of the temporal and parietal bones, but is made use of to join all the edges of the bones on which each temporal muscle is placed: for the two parts of the sphenoidal suture which are continued from the anterior end of the common squamous suture just now described, one of which runs perpendicularly downwards and the other horizontally forwards; and also the lower part of the coronal suture already taken notice of, may all be justly said to pertain to the squamous suture.

This structure appears to depend upon the pressure of the temporal muscle externally, and the resistance of the brain within, which make the bones so thin, that their edges opposed to each other are not sufficiently thick to stop the extension of their fibres in length, and thus to cause the common serrated appearance of sutures; but the narrow edge of the one bone slides over the other. The squamous form is also more convenient here; because such thin edges of bones, when accurately applied one to another, have scarce any rough surface, to obstruct or hurt the muscle in its contraction; which is still further provided for, by the manner of laying these edges on each other; for, in viewing their outside, we see the temporal bones covering the sphenoidal and parietal, and this last supporting the sphenoidal, while both mount on the frontal, from which disposition it

is evident, that while the temporal muscle is contracting, which is the only time it presses strongly in its motion on the bones, its fibres slide easily over the external edges. Another advantage of this structure is, that the whole part is made stronger by the bones thus supporting each other.

The indentations of the sutures are not so strongly marked on the inside as on the outside of the cranium; and sometimes the bones seem to be joined by a straight line: in some skulls, the internal surface is found entire, while the sutures are manifest without. By this mechanism, there is no risk of the sharp points of the bones growing inwards, since the external serræ of each of the conjoined bones rest upon the internal smooth edged table of the other.

The advantages of the sutures are these: 1. The cranium is more easily formed and extended into a spherical figure, than if it had been one continued bone. 2. The bones which are at some distance from each other at birth, may then yield, and allow to the head a change of shape, accommodated to the passage it is engaged in. Whence, in difficult parturition, the bones of the cranium, instead of being only brought into contact, are sometimes made to mount one upon the other.

[The sutures which unite the bones of the cranium, are generally said to be made by the radii of ossification, from the opposite bones meeting and passing each other, so as to form a serrated edge. This explanation is however insufficient, for the following reasons: we always find the sutures in the same relative situation, and observing the same course in the cranium; if they, then, depended exclusively on so mechanical a process, as the shooting of the rays of bone across each other when they met, in ossification on one side of the head occurring sooner or faster than on the other, we ought to find the sa-

gittal suture to one side of the middle line; it should also, in many instances, be found crooked. Moreover, in all cases where bones arise from different points of ossification and meet, particularly in the flat bones, the serrated edges ought to be formed; this, however, is not the case. The os occipitis, which is formed originally from four points of ossification, and has therefore as many bones composing it in early life, never joins these bones together by the serrated edge; the acromion process of the scapula is never united to its spine by suture; the three bones of the sternum never unite by suture; and the same observation holds good in many other instances. Bichat, who rejects this mechanical doctrine, advances an opinion much better founded. The dura mater and the pericranium before ossification commences, form one membrane, consisting of two lamina; it is generally known that the flat bones of the cranium are secreted between these two lamina; now the outline of each bone, long before it has reached its utmost limits, is marked off by partitions passing between these two membranes. The peculiar shape of the bony junction, or of the suture in adult life, will therefore depend upon the original shape of the partitions; when the latter are serrated, the points of ossification will fill up these serræ; but when they are simply oblique, the squamous suture will be formed. This also accounts for cases where the mode of junction is intermediate to the squamous and serrated suture; for the formation of the ossa triquetra, and why in some skulls they do not exist, whereas in others their extent and number are very considerable. The inference will also be drawn from this, that in all ossifications from different nuclei, where these original membranous septa do not exist, a suture will not be formed; but the bones will join each other, as in a case of callus between the broken extremities of

bones. When these septa become weak or thin, either from original tendency, as in the case of the sagittal suture, which in early life is continued to the root of the nose frequently; or from advanced age, as in the case of nearly all sutures, the bones of the opposite sides amalgamate, and no appearance of suture is left. It is easy to make a preparation illustrative of these facts, and one now exists in the museum of the university of Pennsylvania, in which, by removing the bone from between the membranes by means of an acid, and afterwards rendering the membranes transparent with oil of turpentine, the septa are seen sufficiently distinctly.]

Os Frontis.

The os frontis, as its name imports, forms the front part of the cranium, and the upper portion of the orbits of the eyes.

The external surface of this bone is smooth at its upper convex part; but several processes and cavities are observable below: for at the angles of each orbit, the bone projects to form four processes, two internal, and as many external; which are denominated *angular*. Between the internal and external angular processes on each side, an arch ridge is extended, on which the eyebrows are placed. Very little above the internal end of each of these *superciliary ridges*, a protuberance may be remarked in most skulls, where there are large cavities within the bone, called *sinuses*. Between the internal angular processes, and in front of the vacuity for the ethmoid bone, the edge of the os frontis, is serrated for articulation with the ossa nasi, and the processes of the upper maxillary bone; and from the centre of this surface a small process arises, which is called the *nasal spine*. From the under part of the superciliary ridges, the frontal bone runs a great way backwards: these parts are

called *orbitar* processes, which, contrary to the rest of this bone, are concave externally, for receiving the globes of the eyes. with their muscles, fat, &c.

In each of the orbitar processes, behind the middle of the superciliary ridges, a considerable sinuosity is observed, where the glandula lacrymalis is lodged. Near each internal angular process, a small pit may be remarked, where the cartilaginous pully of the superior oblique muscle of the eye is fixed. Between the two orbitar processes, there is a large vacuity which the cribriform part of the os ethmoides occupies. The frontal bone has frequently little caverns formed in it where it is joined to the ethmoid bone.

The foramina, or holes, observable on the external surface of the frontal bone, are three in each side.

On each superciliary ridge, at the distance of one-third of its length from the nose, is a foramen, or a notch, through which pass a branch of the ophthalmic artery and a small nerve.

In the internal edge of each orbitar process are two other foramina denominated *anterior* and *posterior orbitar foramina*, which lead to the nose; sometimes they are only notches or grooves, which join with similar grooves in the bones below, and form foramina.

The internal surface of the os frontis is concave, except at the orbitar processes, which are convex, and support the anterior lobes of the brain. This surface is not so smooth as the external; for the larger branches of the arteries of the dura mater make some furrows in its sides and back parts, and its lower and fore parts are marked with the convolutions of the anterior lobes of the brain. In the middle of the concave internal surface is a groove, which is small at its commencement, and gradually increases in diameter as it proceeds upwards. This is formed by the superior longitudinal sinus; at its commence-

ment is a ridge to which the beginning of the falciform process of the dura mater is attached. At the root of this ridge is a small foramen, sometimes formed jointly by this bone and the ethmoid: it is denominated *foramen cæcum;* in it a small process of the falx is inserted, and here the longitudinal sinus begins.

The frontal sinuses are formed by the separation of the two tables of this bone at the part above the nose and the internal extremities of the superciliary ridges. In the formation of these cavities, the external table commonly recedes most from the general direction of the bone.

These cavities are divided by a perpendicular bony partition, which is sometimes perforated and admits a communication between them. Their capacities are often very different in different persons, and on the different sides of the same person. In some persons whose foreheads were very flat, they are said to have been wanting. They communicate with the nose by means of a canal in the cellular part of the os ethmoides.

The os frontis is composed of two tables, and an intermediate diploë, as the other bones of the cranium are: it is of a mean thickness between the os occipitis and the parietal bones; and is nearly equally dense throughout, except at the orbitar processes, where, by the action of the eye on one side, and pressure of the lobes of the brain on the other, it is made extremely thin and diaphanous, and the diploë is entirely obliterated. In this place there is so weak a defence for the brain, that fencers esteem a push in the eye mortal.

In such skulls as have the frontal bone divided by the sagittal suture, the partition separating these cavities is evidently composed of two plates, which easily separate.

Each of the frontal sinuses opens into one of the uppermost cells in the anterior part of the ethmoid bone, and this cell communicates with the middle channel of the nose under the anterior end of the *os turbinatum superius.*

This bone is united with the parietal, ethmoidal and sphenoidal bones of the head; and with the nasal, maxillary, unguiform and malar bones of the face.

Ossa Parietalia.

Each of the two *ossa Parietalia* is an irregular square; its upper and front edges being longer than the one behind or below. The inferior edge is concave, the middle part receiving the upper round part of the temporal bone. The angle formed by the under and anterior edges is so extended as to have the appearance of a process.

The *external surface* of each os parietale is convex. Upon it, somewhat below the middle height of the bone, there is a transverse arched ridge, generally of a whiter colour than any other part of the bone; from which, in bones that have strong prints of muscles, we see a great many converging furrows, like so many radii drawn from a circumference towards a centre. From this ridge of each bone the temporal muscle rises: and, by the pressure of its fibres, occasions the furrows just now mentioned. Below these we observe, near the semicircular edges, a great many risings and depressions, which are joined to like inequalities on the inside of the temporal bone, and form the squamous suture. Near the upper edges of these bones, towards the hind part, is a small hole in each, through which a vein passes from the teguments of the head to the longitudinal sinus.

On the *inner concave surface* of the parietal bones

we see a great many deep furrows, disposed somewhat like the branches of trees; the furrows are largest and deepest at the lower edge of each os parietale, especially near its anterior angle, where a complete canal is sometimes formed.

[These furrows are made by the ramifications of the great middle artery of the dura mater; they have been commonly attributed to the pulsation of the artery causing the absorption of the bone, but it is more probable that the deposition of the bone has been prevented where the artery beats, and thus the bone becomes modelled over the artery in the same way that it is made to conform to the surface of the brain. If it were exclusively an absorption and not a deposition, we should scarcely find the artery occasionally surrounded perfectly by bone.]

On the inside of the upper edge of the ossa parietalia there is a large sinuosity, frequently larger in the bone of one side than of the other, where the upper part of the falx is fastened, and the superior longitudinal sinus is lodged. Part of the lateral sinuses generally makes a depression near the angle formed by the lower and posterior edges of these bones; and the pits made by the convolutions of the brain are in no part of the skull more frequent or more conspicuous, than in the internal surface of these bones.

The ossa parietalia are the most equal and smooth, and are among the thinnest bones of the cranium; but they enjoy the general structure of two tables and diploë most perfectly.

These bones are joined at their foreside to the os frontis; at their long inferior angles, to the sphenoid bone; at their lower edge, to the ossa temporum; behind to the os occipitis, or ossa triquetra; and above, to one another.

Ossa Temporum.

The *ossa temporum* are situated at the lateral and inferior parts of the cranium; each of them is divided into three portions, a superior or squamous, a posterior or mastoid, and a middle or petrous.

The *squamous portion* is nearly semicircular in form and very thin; its edge is sharp, and the inner table appears pared away to form the squamous suture with the corresponding edge of the parietal bone. Its external surface is covered by the temporal muscle. At the lower and anterior part of this surface the zygomatic process arises, it proceeds forward to join the cheek bone and form an arch under which the temporal muscle passes.

At the base of the process is the cavity for the condyle of the lower jaw. Immediately before this cavity is a tubercle or protuberance, which forms part of the articular surface on which the condyle rises when the jaw is opened. In the posterior part of the cavity is a fissure, in which part of the ligament of this articulation is fixed. In this fissure is an aperture which communicates with the cavity of the tympanum of the ear, and is occupied by a small nerve called *chorda tympani*, and also by the anterior muscle of the malleus, one of the small bones of the ear.

The internal surface of the squamous portion is concave; it is marked by pits and small eminences, which correspond with the convoluted surface of the brain, and also by impressions of the arteries of the dura mater, as they go towards the parietal bone.

The *mastoid* or *occipital portion* is the smallest of the three parts of the bone; it consists of an angular portion, which occupies a vacuity between the occipital and parietal bones; and of the mastoid process. The mastoid process has some resemblance to the nipple; it is composed internally of cells which com-

municate with the cavity of the tympanum. On the internal side of its base is a deep groove in which the posterior belly of the digastric muscle is inserted. Behind this process is the mastoid hole, which transmits a vein, and sometimes a small artery.

On the internal surface of this portion is a large groove, which is formed by the lateral sinus. The mastoid hole above mentioned opens into this groove.

The *petrous portion*, which is situated between the squamous and mastoid, resembles a triangular pyramid lying on one of its sides. When in its proper position it projects inward and forward. The two upper sides form a portion of the internal surface of the base of the cranium. The angle formed by these surfaces is very prominent, and divides the fossa for the middle lobes of the brain, or cerebrum from those which contain the cerebellum.

One of these *sides* of the petrous portion looks forward and outward, the other backward and inward. Each of them has eminences and depressions to correspond with the convolutions of the brain. Near the middle of the *anterior side* is a small furrow, and a foramen denominated *Innominatum* or *Hiatus Fallopii*, which transmits the vidian nerve to the aqueduct of Fallopius.

About the midle of the *posterior side* is the large aperture called *meatus auditorius internus*. The bottom of this cavity is perforated by several foramina: the largest and uppermost of which is the orifice of a winding canal, called improperly the *aqueduct* of Fallopius, which transmits the portio dura of the seventh pair of nerves. The other foramina transmit the fibres of the portio mollis of the same nerve. Posterior to the orifice of the meatus internus is an oblong depression, with a foramen in it, covered by a shell of bone, which is the orifice of a proper aque-

duct or canal that passes from the vestibule of the ear.*

The *inferior side* of the *petrous portion* forms a part of the external surface of the basis of the cranium. On the back part of it is the external orifice of the canal through which the portio dura passes. It is called *foramen stylo mastoideum.* Before this foramen is a long and slender styloid process, which varies from one to two inches in length; it projects almost perpendicularly from the basis of the cranium, and gives origin to a muscle of the tongue, of the os hyoides, and of the pharynx, and also to several ligaments. [The base of this process is surrounded by a flat projection of bone, occasionally called the vaginal process.]

On the inside of this process, and rather before it, is the jugular fossa, which, when applied to a corresponding part of the occipital bone, makes the posterior foramen lacerum, through which the internal jugular vein, and the eighth pair of nerves pass out. A small spine often projects into this foramen from the temporal bone, and separates the nerve from the vein; the nerve being anterior. Before this spine, or partition, is the orifice of the second aqueduct of the ear, the aqueduct of the cochlea. This jugular fossa is at the termination of the groove, in the internal surface of the bone, made by the lateral sinus. At a small distance before the jugular fossa is the commencement of the carotid canal, which makes a curve almost semicircular, and then proceeds in a horizontal course to the anterior extremity of the bone; through this winding canal passes the carotid artery, and the filaments from the fifth and sixth pair of nerves, which are the beginning of the intercostal nerve.

* This orifice should not be confounded with one which is nearer to the meatus internus, and situated on the angle made by the two sides of the bone.—Ed.

Between the carotid canal and the cavity for the condyle of the lower jaw, at the junction of the anterior part of the squamous portion with the petrous portion of this bone, is a very rough aperture, the bony margin of which appears broken; this is the orifice of the bony part of the *Eustachian* tube, or passage from the throat to the ear. This canal is divided lengthwise by a thin bony plate; the upper passage contains the internal muscle of the malleus bone of the ear; the lower and largest canal is the body part of the Eustachian tube.

The external passage to the ear, called *Meatus Auditorius Externus*, is situated between the zygomatic and the mastoid processes. The orifice is large and smooth above, but rough below, and is sometimes called the auditory process. The direction of the canal is obliquely inward and forward.

The *temporal* is articulated with the *parietal*, *occipital* and *sphenoidal* bones, and by its *zygomatic* process with the *malar* bone.

Os Occipitis.

The *occipital bone* is situated at the posterior and inferior part of the cranium, it is of a rhomboidal figure with convex and concave surfaces.

The upper part of the external surface is smooth; at a small distance above the middle of the bone is the external occipital protuberance, with a curved line on each side of it. Near the middle of the bone the trapezii muscles are attached to this line, and externally, on each side, the occipito frontalis, and the sterno mastoideus. Under this line is a depression, on each side, into which are inserted the complexus and the splenius capitis muscles.

Below this is the inferior curved line, and still lower is a muscular depression to which the rectus minor posticus is attached, on each side near the

middle; and the rectus major, and obliquus superior, near the end.

Below the protuberance is a spine which passes down the middle of the bone, and at the lower extremity of this spine is the great occipital foramen, which forms the communication between the cavities of the cranium, and the vertebral column. This great opening transmits the medulla spinalis with its membranes, the accessory nerves of Willis, and the vertebral arteries and veins.

It is rather of an oval form, and the occipital condyles are situated anteriorly on its edges. These condyles are of an irregular oval figure; they are not parallel, but incline towards each other anteriorly. Their articulating surfaces are oblique, looking downward and outward; they are received into corresponding cavities of the atlas, or first cervical vertebra, and form with them the articulation of the head and neck. From the oblique position of their articulating surfaces, as well as the length of their ligaments and the inclination of their axes towards each other, it results, that their motion is confined to flexion and extension. On the internal sides of these condyles is a rough surface to which are attached the strong ligaments that come from the processus dentatus of the second vertebra of the neck.

Behind each condyle is a depression in which is situated the posterior condyloid foramen, for transmitting the cervical veins; and at their anterior extremities are two large foramina, through which pass the ninth pair of nerves.

On the internal surface of the os occipitis is the crucial ridge, to which are attached the *falx*, or *vertical*, and the *tentorium*, or *horizontal* process of the dura mater.

The groove made by the longitudinal sinus continues from the sagittal suture along the upper limb

of this cross. Sometimes it is on the side of the ridge, and sometimes the ridge is depressed, and it occupies its place, at the centre of the cross, the groove for the longitudinal sinus divides into two grooves, for the lateral sinuses; these form the horizontal limbs of the cross, and proceed towards the foramen lacerum where the lateral sinuses emerge from the cavity of the cranium. The lower limb of the cross is formed by a spine which proceeds from the centre to the great occipital foramen, and supports the falx of the cerebellum. The internal surface of the bone is divided by the cross into four portions, each of which is considerably depressed; the two upper by the posterior lobes of the cerebrum, and the lower by those of the cerebellum.

This circumstance occasions great inequality in the thickness of the bone, as the depressed portions are extremely thin, while the ridge adds greatly to the thickness, especially at the centre of the cross, which is opposite to the great external protuberance.

Before the great occipital foramen is the cuneiform process, which is thick and substantial; it terminates by a broad truncated extremity, which is articulated with the body of the sphenoid bone. The internal surface of the cuneiform process is somewhat excavated, and forms a large superficial groove for the medulla oblongata; on each side of this groove is a small furrow for the inferior petrous sinuses.

The two upper edges of the occipital bone are serrated, to articulate with those of the parietal, and form the lambdoidal suture. The inferior edges are divided into two portions by a small prominence called the *jugular eminence;* the upper and posterior portion is also serrated for articulation with the mastoid portion of the temporal; the inferior portion, which is not serrated, applies to the petrous portion

of the temporal bone, and a notch in it contributes to the formation of the foramen lacerum.

The upper angle of this bone is acute, the lateral angles are obtuse, and the inferior truncated. It is articulated with the parietal, the temporal, and the sphenoidal bones.

Os Ethmoides.

The *os ethmoides* is truly one of the most curious bones of the human body. It appears almost a cube, not of solid bone, but exceedingly light and spongy, and consisting of many convoluted plates, which form a network like honey-comb. It is firmly inclosed in the os frontis, betwixt the orbitary processes of that bone. One horizontal plate receives the olfactory nerves, which perforate that plate with such a number of small holes, that it resembles a sieve; whence the bone is named cribriform, or ethmoid. Other plates are so arranged that they form a cellular structure, on which the olfactory nerves are expanded by means of a particular membrane; while an additional plate, appropriated to the nose, descends into that cavity in a perpendicular direction, and forms a large proportion of the partition which divides it into two chambers.

The cribriform plate is situated in the anterior part of the basis of the cranium. The cellular part occupies most of the space between the orbits of the eyes, and the perpendicular plate is to be found in the septum of the nose.

The ethmoid bone, for the purposes of description, may be divided into three parts, viz. the *cribriform plate*, the *nasal* or *perpendicular lamella*, and the *cellular portions.*

The *cribriform plate* is oblong in shape, and firm in its structure; in the middle of the anterior extremity the crista galli projects from its upper surface.

dividing it into two lateral portions, each of which is rather concave, and occupied by the bulbous extremity of the olfactory nerve; it is perforated by many foramina, which transmit the fibres of the aforesaid nerve. Near the crista galli, on each side, there is a small fissure, through which passes a nervous fibre derived from the ophthalmic branch of the fifth pair. The crista galli varies in size in different subjects: the beginning of the falciform process of the dura mater is attached to it, and with the opposite part of the os frontis it forms the foramen cæcum, already mentioned. It is very conspicuous in the basis of the cranium.

The *nasal plate* of the ethmoid bone seems to be continued downwards from the crista galli through the cribriform plate. It is thin, but firm; it forms the upper portion of the septum of the nose, and to complete the partition, it unites with the vomer and with a plate of cartilage before. It is very often inclined to one side, so that the nostrils are not of equal size.

At a small distance from this perpendicular plate, on each side of it, the *cellular portions* originate from the lower surface of the *cribriform plate*; they extend from before backward, and are as long as the ethmoid bone; their breadth, between the eye and the cavity of the nose, varies in different subjects, from half an inch to more; they extend downwards from the root of the nose, or from the cribriform plate, more than half way to the roof of the mouth. Their external surface on each side forms a part of the surface of the orbit of the eye, and is called *os planum*; their internal surface forms part of the external lateral surface of each nostril. This surface extends the whole depth of the nostril, from before backward, but in many skeletons is extremely imperfect, owing to the great brittleness of the bony plates of which it

is composed. When the bone is perfect, the uppermost half part of this internal surface is uniformly flat, and rather rough; but below it, about the middle of the bone, a deep groove begins, which extends downwards and backwards, to the posterior extremity: this is the *upper channel* or *meatus* of the nose. The edge of the surface immediately above it projects in a small degree over this channel or groove; having been described by Morgagni, it bears his name, and may be considered as one of the spongy or turbinated bones; from its situation, it should be called the first. The groove is very deep, and most of the cells of the *posterior part of the ethmoid bone communicate with it, through one or more foramina at its anterior extremity.* The part of the surface of the ethmoid which is immediately below this groove, is convex; that which is before and below it, is rather flat; the convex part is *the upper spongy or turbinated bone*, as it has commonly been called; it projects obliquely into the cavity of the nose, and hangs over the middle channel or meatus, which is immediately below the ethmoid bone. The internal surface of this spongy bone, which is opposite the septum of the nose, is convex and rough or spongy; the external surface is concave. The *anterior cells* of the ethmoid, and particularly those which the *frontal sinuses* on each side communicate with, open into the middle channel or meatus, under the anterior end of this turbinated bone.

This *middle channel* or *meatus*, is much larger than that above; it extends from the anterior to the posterior part of the nostrils, and slopes downwards and backwards. The cavity of the upper maxillary bone, or the antrum highmorianum, opens on each side into this meatus, and a thin plate of bone extends from the cellular part of the ethmoid so as to cover a part of it.

The *cellular portions of the ethmoid* are composed of plates thinner than the shell of an egg; they are entirely hollow, and the cells are very various, in number, size and shape. Some cells of the uppermost row communicate with those of the os frontis, formed by the separation of the plates of the orbitar processes of that bone.

From the posterior part of the cribriform plate, where it is in contact with the lesser wings of the sphenoidal bone, thin plates of bone pass down upon the anterior surface of the body of the os sphenoides, one on each side of the azygos process, and often diminish the opening into the sphenoidal cells. These plates are sometimes triangular in form, the bases uniting with the cribriform plate. They have been described very differently by different authors, some considering them as belonging to the os ethmoides, and others to the sphenoid bone. To the perfect ethmoid bone there are attached two triangular pyramids, in place of the triangular bones; these pyramids are hollow, the azygos process of the os spenoides is received between them; one side of each pyramid applies to each side of the azygos process, another side applies to the anterior surface of the body of the sphenoid bone, in place of the ossa triangularia, and the third side is the upper part of one of the posterior nares.* There are two apertures in each of these pyramids; one at the base opening directly into the nose, near the situation of the opening of the sphenoidal sinues, in the bones of adults; and the other in each of the sides in contact with the azygos process.

* This may be considered as an original observation of the lamented Wistar. The merit of it has been denied to him, more particularly by the anatomists of Paris, under an impression that he had been anticipated in it by Bertin, who has written an excellent and minute treatise on osteology. The extent to which the claims of other anatomists interfere with his, he was fully aware of; and it

Os Sphenoides.

The *os sphenoides*, or *pterygoides*, resembles a bat with its wings extended. It consists,

will be seen by the following communications to the American Philosophical Society, that these are placed in as important a light as they deserve, at the same time that he vindicates his own pretensions, to have first observed the "cornets sphenoidaux" in the form of triangular hollow pyramids, as constituting part of the perfect ethmoid bone. Ed.

Observations on those Processes of the Ethmoid Bone which originally form the Sphenoid Sinuses. By C Wistar, M. D President of the Society, Professor of Anatomy in the University of Pennsylvania.—Read, Nov. 4, 1814.

It had been long believed that the Sinuses, or cavities in the the body of the Os Sphenoides, were exclusively formed by that bone, when Winslow suggested that a small portion of the orbitar processes of the Ossa Palati contributed to their formation.*

Many years after Winslow's publication, Monsieur Bertin described two bones which form the anterior sides of those sinuses, and contain the foramina by which they communicate with the nose.†

These bones he denominates "Cornets Sphenoidaux," and states that they are most perfect and distinct between the ages of four years and of twenty; that they are not completely formed before this period, and that after it, they appear like a part of the Sphenoidal bone.—According to his account they are lamina of a triangular form, and are originally in contact with the anterior and inferior surface of the body of the Os Sphenoides, so that they form a portion of the surface of the cavity of the nose. —He believed, that as they increase in size, they become convex and concave, and present their concave surfaces to the body of the sphenoidal bone, which also becomes concave, and presents its concavity to those bones; thus forming the sinuses.

This account of M. Bertin has been adopted by Sabatier, and also by Boyer, who has improved it by the additional observation, that these triangular bones are sometimes united to the ethmoid, and remain attached to that bone when it is separated from the Os Sphenoides. Bichat and Fyfe, have confirmed the description of Boyer.

The specimens of Ethmoid and Sphenoid bones, herewith exhibited to the society, will demonstrate, that in certain subjects, about two years of age, there are continued from the posterior part of the cribriform plate of the Ethmoid, *two Hollow Triangular Pyramids* which, when in their proper situation, receive between them the azygos process of the Os Sphenoides.—(See Plate X. Figures 1, 2, 3, with the explanation.)

The internal side of each of these pyramids applies to the aforesaid

* In his description of the Ossa Palati, printed in the Memoirs of the Academy of Sciences, for 1720.

† See Memoirs of the Academy of Sciences for 1771.

1st, Of a *body* with two processes arising from it, called the *lesser wings*, or apophyses of Ingrassias.

2dly, Of two large lateral processes, called the *greater wings*, or temporal processes; and,

3dly, Of two vertical portions, denominated *pterygoid processes.*

azygos process; the lower side of each forms part of the upper surface of the Posterior Nares; the external side at its basis is in contact with the Orbitar Process of the Os Palati. The base of each pyramid forms also a part of the surface of the Posterior Nares, and contains a foramen which is ultimately the opening into the Sphenoidal Sinus of that side.

In the Sphenoidal Bones which belong to such Ethmoids as are above described, there are no cells or Sinuses; for the pyramids of the Ethmoid bones occupy their places. The azygos process, which is to become the future septum between the Sinuses, is remarkably thick, but there are no cavities or Sinuses in it.

The sides of the pyramids which are in contact with this process are extremely thin, and sometimes have irregular foramina in them, as if their osseous substance had been partially absorbed.* That part of the external side of the pyramid which is in contact with the orbitar process of the Os Palati is also thin, and sometimes has an irregular foramen, which communicates with the cells of the aforesaid orbitar process.

Upon comparing these perfect specimens of the Ethmoid and Sphenoidal Bones of the subject about two years of age, with the Os Sphenoides, of a young subject who was more advanced in years, it appears probable, that the azygos process and the sides of the pyramid applied to it, are so changed, in the progress of life, that they simply constitute the septum between the Sinuses; that the external side of the pyramid is also done away, and that the front side and the basis of the pyramid only remain; constituting the Cornets Sphenoidaux † of M. Bertin.

If this be really the case, the origin of the Sphenoidal Sinuses is very intelligible.

Explanation of the Figures in the Plate referred to above.

FIG. I.

Represents the upper surface, or cribriform plate of the Ethmoid Bone.

a. Crista Galli.
b b b b. Cribriform plate.
c. Surface denominated Os Planum.
d d. Hollow Triangular Pyramids.
e. Space between the Pyramids for receiving the Azygos Process of the Os Sphenoides.

* See *e*, fig. 3.

† "Cornet" is the word applied by several French anatomists to the Ossa Turbinata of the nose; they seem to have intended to express by it a convoluted lamina or plate of bone.

Fig. 1.

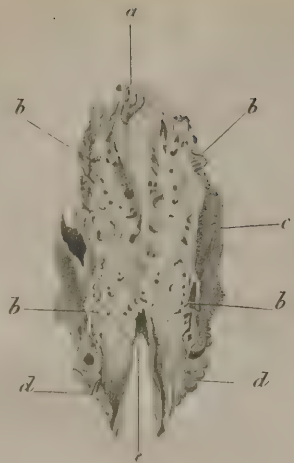
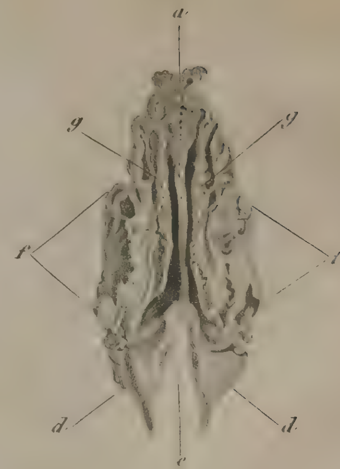


Fig. 2.

Fig. 3.



The *body* is situated near the centre of the cranium, in contact with the cuneiform process of the occipital bone; the *greater wings* extend laterally between the frontal and temporal bones as high as the parietal; while *the pterygoid* processes pass downwards on each side of the posterior opening of the nose, as low as the roof of the mouth. It is therefore in contact with all the other bones of the cranium, and with many bones of the face.

The *body* has a cubic figure, its *upper* surface forms a portion of the basis of the cranium; its *lower* and *anterior surfaces* form part of the cavity of the nose; the *posterior surface* is articulated with the cuneiform process of the occipital bone; and laterally it is extended into the great wings, or temporal processes.

On the upper surface of the body, the lesser wings or the aphophyses of Ingrassias,* project from the lateral and anterior parts; these wings consist of two triangular plates, each of which is joined to the other

FIG. II.

A lateral View of the Bone.

a. Christa Galli.
c. Os Planum.
d. Triangular Pyramid.

FIG. III.

The Bone inverted.

a. The Nasal Plate of the Ethmoid Bone, which constitutes the upper portion of the Septum of the nose.
g g. Those portions of the Ethmoid which are called Superior Turbinated Bones.
f f. The Cellular Lateral portions of the Bone.
d d. The Triangular Pyramids.
e. Space between the Pyramids for the Azygos Process of the Os Sphenoides—a foramen on the internal side of one of the Pyramids.

The fine drawing of the Ethmoid Bone, for this plate, was done by my friend M. Lesueur, whose talents are so conspicuous in the plates attached to Peron's "Voyage de Descouvertes aux Terres Australes.

* A physician of Palermo, who died in 1580, aged 70. Ed

by its base, and to the body of the os sphenoides by its under surface near the base, and terminates in a point; their direction is forwards and outwards, and their flat surfaces are horizontal. Anteriorly they are connected by suture to the ethmoid and frontal bones; their posterior edge is rounded, and detached from any other bone, forming the upper margin of the foramen lacerum of the orbit of the eye; this edge is thick and prominent at its internal extremity, and these prominences are called the *anterior* or *clinoid processes;* immediately before them are the *optic foramina*, which pass obliquely through the wings into the orbit of the eye, and transmit on each side the optic nerve and a small artery.

Behind the *optic foramen* is a notch, and sometimes a foramen, made by the carotid artery. A groove made by the optic nerves, is often seen extending across the body of the bone, from one of the optic foramina to the other. Behind it is a depression, which occupies the greatest part of this surface of the bone, in which the pituitary gland is lodged; the back part of this depression is bounded by a transverse eminence, called the posterior clinoid process. These three processes are called *clinoid* from their supposed resemblance to the supporters of a bed; and the depression for the pituitary gland is called *cella turcica*, from its resemblance to the saddle used by the Turks.

On each side of the posterior clinoid process is a groove in the body of the bone, made by the carotid artery as it passes from the *foramen caroticum* of the temporal bone. The *posterior surface* of the body of the sphenoides is rough, for articulation with the truncated end of the cuneiform process of the os occipitis.

On the *anterior* and *inferior surfaces* is a spine, called the azygos process, which is received into the

base of the vomer, and extends forward until it meets the nasal plate of the ethmoid bone; on each side of this spine, in the *anterior surface*, are the orifices of the *sphenoidal cells.* Those orifices appear very differently in different bones; in some very perfect specimens, they are irregularly oval, being closed below, and on their external sides, by the processes of the ossa palati, and above by the triangular plates, as they have been called, of the ethmoid bone. The cells or sinuses, to which these orifices lead, occupy the body of the sphenoidal bone; they are divided by a partition, and each of them has a communication with the cavity of the nose on its respective side, by the orifice above described. The sinuses do not exist during infancy; they increase in the progress of life, and are very large in old age.

Laterally, the body of the sphenoides is extended into the portions called the *great wings* or *temporal processes.* These *great wings* compose the largest part of the bone, and their internal surface forms a portion of the middle fossa of the base of the cranium. Externally, the surface of each great wing is divided into two portions: one of which is lateral, and unites to the frontal, temporal, and malar bones, forming part of the smooth surface for the temporal muscle; the other portion forms part of the orbit of the eye, and is very regular and smooth. As the ethmoid bone forms part of the inside, this portion of the great wing forms part of the outside of the orbit, and is termed the *orbitary process* of the sphenoid bone. The horizontal part of each wing terminates in an acute angle termed *spinous process*, which penetrates between the petrous portion and the articulating cavity of the temporal bone. In this angle is the foramen for the principal artery of the dura mater; near the point of the angle is a small process,

which projects from the basis of the cranium, and is called *styloid.*

The *pterygoid processes* pass downwards in a direction almost perpendicular to the base of the skull. Each of them has two plates, and a middle fossa facing backwards; to complete the comparison, they should be likened to the legs of the bat, but are inaccurately named pterygoid, or wing-like processes, The external plates are broadest, and the internal are longest. From each side of the external plates the pterygoid muscles take their rise. At the root of each internal plate, a small hollow may be remarked, where the musculus circumflexus palati rises, and part of the cartilaginous end of the Eustachian tube rests. At the lower end of the same plate is a hook-like process, round which the tendon of the last named muscle plays, as on a pulley. The ossa palati, on each side, rest upon these internal plates; and therefore the pterygoid processes seem to support the whole face.

Foramina of the Sphenoidal Bone.

Before these foramina are described, it is necessary to state, that the nerves of the brain are named numerically, beginning with the olfactory, which is foremost.

It should also be observed, that each nerve, of the fifth pair, is divided, before it passes from the cavity of the cranium into three large branches.

The first foramina are the *optic*, which have been already described; they transmit the optic, or second pair of nerves, and a small artery, to the ball of the eye.

The second foramen, on each side, is the *foramen lacerum.* It commences largely at the sella turcica, and extends laterally a considerable distance, until, it is a mere fissure. The upper margin of this foramen is formed by the anterior clinoid processes, and the edges of the smaller wings of the sphenoid bone.

This foramen transmits the third, fourth and sixth pair of nerves, and the first branch of the fifth pair, to the muscles, and the other parts, subservient to the eye.

The *foramen rotundum*, or third hole, is round; as its name imports. It is situated immediately under the foramen lacerum, on each side, and transmits the second branch of the fifth pair of nerves to the upper maxillary bone.

The *foramen ovale* is the fourth hole. It is larger than the foramen rotundum, and half an inch behind it. It transmits the third branch of the fifth pair of nerves to the lower jaw.

The fifth hole is the *foramen spinale.* It is small and round, and placed in the point of the spinous process, behind the foramen ovale, to transmit the principal artery of the dura mater, which makes its impression upon the parietal bone.

The sixth foramen is under the basis of each pterygoid process, and is therefore called the *pterygoid*, or the *vidian* foramen.* It is almost hidden by the point of the petrous portion of the temporal bone, and must be examined in the separated bone. It is nearly equal in size to the spinous hole.

This foramen transmits a nerve that does not go out from the cavity of the skull, but returns into it. The second branch of the fifth pair, after passing out of the cranium, sends back, through this foramen, a branch called the *vidian*, which, upon its arrival in the cavity of the cranium, enters the temporal bone by the foramen innominatum.

Of the Face.

The *face* is the irregular pile of bones composing

* From its reputed discoverer, Vidius, a professor at Paris

the front and under part of the head, and is divided into the upper and lower maxillæ, or jaws.

The *upper jaw* consists of six bones on each side, of one single bone placed in the middle, and of sixteen teeth.

The thirteen bones are, two ossa maxillaria superiora, two ossa nasi, two ossa unguis, two ossa malarum, two ossa palati, two ossa spongiosa inferiora and the vomer.

The *ossa maxillaria superiora* form the principal part of the cavity of the nose, with the whole lower and forepart of the upper jaw, and a large proportion of the roof of the mouth.

The *ossa nasi* are placed at the upper and front part of the nose.

The *ossa unguis* are at the internal angles of the orbits of the eyes.

The *ossa palati* in the back part of the palate, extending upwards to the orbits of the eyes.

The *ossa spongiosa* in the lower part of the cavity of the nose; and

The *vomer* in the partition which separates the two nostrils.

Ossa Maxillaria Superiora.

The *ossa maxillaria superiora*, or *upper jaw-bones*, may be considered as the basis or foundation of the face; as they form a large part of the mouth, the nose, and the orbit of the eye.

The central part of each bone, which may be considered as its body, is hollow, and capable of containing, in the adult, near half an ounce of fluid. The plate which covers this cavity is the bottom of the orbit of the eye. The sockets of the large teeth are below it. The roof of the mouth projects laterally from the inside of it. A process for supporting the cheek bone is on the outside; and another process goes up before it, which forms the side of the nose,

In each *upper maxillary bone* the following parts are to be examined.

The *nasal process*; the *orbitar plate*; the *malar process*; the *alveolar process*; the *palatine process*; the *anterior* and *posterior surfaces*; the *great cavity*; the *internal* or *nasal surface*; and the *three foramina*.

The *nasal process*, which extends upwards to form the side of the nose, is rather convex outwards, to give the nostril shape. Its sides support the nasal bone; and a cartilage of the alæ nasi is fixed to its edge.

The margin of the orbit of the eye is marked by a sharp ridge on the external surface of this process; and the part posterior to this ridge is concave, to accommodate the lachrymal sac.

The *orbitar plate*, which covers the great cavity, and forms the bottom of the orbit, is rather triangular in form, and concave. In the posterior part is a groove, which penetrates the substance of the bone, as it advances forward, and terminates in the infra-orbitary foramen, below the orbit. At the place where this plate joins the nasal process above mentioned, viz. at the inner angle of the orbit, is the commencement of the bony canal, which transmits the lachrymal duct into the cavity of the nose.

The *malar process* projects from the external and anterior corner of the orbitar plate; it supports the malar bone, and is rough for the purpose of articulating with it.

The *alveolar processes* compose the inferior and external margins of the upper maxillary bones. When these bones are applied to each other they form more than a semi-circle; their cavities contain the roots of the teeth, and corespond with them, in size and form. They do not exist long before the formation of the teeth commences; they grow with the teeth; and when these bodies are removed, the alveoli disappear.

The *palate process* is a plate of bone, which divides the nose from the mouth, constituting the roof of the palate, and the floor or bottom of the nostrils. It is thick where it first comes off from the alveolar process; it is thin in its middle; and it is again thick where it meets its fellow of the opposite side. At the place where the two upper jaw-bones meet, the palate plate is turned upwards, so that the two bones are opposed to each other in the middle of the palate, by a broad flat surface, which cannot be seen but by separating the bones. This surface is so very rough, that the middle palate suture almost resembles the sutures of the skull; and the maxillary bones are neither easily separated, nor easily joined again. The meeting of the palate plates, by a broad surface ,makes a rising spine, or sharp ridge, towards the nostrils; so that the breadth of the surface by which these bones meet, serves a double purpose; it joins the bones securely, and it forms a small ridge upon which the edge of the vomer or partition of the nose, is planted. Thus we find the palate plates of the maxillary bones conjoined, forming almost the whole of the palate; while what are properly called the palate bone forms a very small share of the back part only. As these thinner bones of the face have no medulla, they are nourished by their periosteum only, and are of course perforated with many small holes.

The *anterior surface* of the upper maxillary bone is concave; the margin formed by the lower edge of the orbit, by the malar process, and by the alveolar processes, being more elevated than the central part. At a small distance below the orbit is the infra-orbitary foramen for transmitting a branch of the superior maxillary nerve. When these two bones are applied to each other, and the ossa nasi are in their places, they form the anterior orifice of the nasal

cavity, which has a small resemblance to the inverted figure of the heart on cards.

The *posterior surface* has been called a process or tuber. It expands to a considerable size, and is united internally and posteriorly to the ossa palati.

The *great cavity* extends from the bottom of the orbit of the eye to the roof of the mouth, and from the anterior to the posterior surface of the bone; it opens in the cavity of the nose, and is called antrum maxillare, or Highmorianum.* There is but a small portion of bone between this cavity and the sockets of the teeth, particularly those of the second molar tooth.

The *internal* or *nasal surface* of this bone forms a large part of the cavity of the nose, and is concave. At the root of the nasal process is a ridge, for supporting the anterior end of the lower turbinated bone. The nasal process seems continued into the cavity of the nose, and forms a portion of the orifice of the canal for the lachrymal duct, which is on the external side of this cavity, near its anterior opening, and under the lower turbinated bone. The orifice in this bone by which the antrum maxillare communicates with the nose, is very large; but it is reduced to a small size, by a plate from the ethmoid bone, by a portion of the ossa palati and of the lower spongy bone, each of which covers a part of it.

The three *foramina* are, 1st. The infra-orbitary foramen already described. 2d. The foramen incisivum or anterior palatine hole, which passes through the palatine process, from the nose to the mouth. In the nose there are generally two foramina, which unite and form but one in the mouth, immediately behind the middle incisior teeth. This foramen is closed by the soft parts during life, and transmits a

* After an anatomist who described it.

branch of the spheno-palatine nerve from each side which runs on the septum narium, and joining at the lower part of the canal with its fellow, they unite, and, according to Mr. Cloquet, form a ganglion. 3d. The posterior palatine foramen, which is formed by this bone, and by the os palati, on each side, is situated in the suture which joins them to each other, and transmits to the palate, a branch of the upper maxillary nerve.

This bone is united to the frontal, nasal, unguiform, ethmoid and malar bones, above; to the ossa palati behind; to the corresponding bone, on the opposite side; and to the inferior spongy bone, in the cavity of the nose.

Ossa Nasi.

The *ossa nasi* are so named from their prominent situation at the root of the nose. They are each of an irregular oblong figure, being broadest at their lower end, narrowest near the middle, and larger again at the top, where the edge is rough and thick, and their connexion with the os frontis is consequently very strong. They are convex externally, and concave within. The lower edges of these bones are thin and irregular. Their anterior edges are thick, and their connexion with each other, by means of their edges, is firm; the suture between them, extending down the middle of the nose, forms a prominent line on the internal surface, by which they are united to the septum narium. The uppermost half of their posterior edges is covered by the edges of the nasal processes of the upper maxillary bones; the lower half laps over the edges of these bones; and by this structure they are enabled to resist pressure. [On the posterior surface of the os nasi is a groove occupied in the recent subject by a branch of the ophthalmic nerve called the nasal, which enters

the nose through the foramen orbitare internum anterius.] They are joined above to the os frontis; before, to each other; behind, to the upper maxillary bones; below, to the cartilages; and internally, to the septum of the nose.

Ossa Unguis.

The ossa unguis are so named from their resemblance to a nail of the finger. They are situated on the internal side of the orbit of the eye, between the os planum of the ethmoid, and the nasal process of the upper maxillary bone. Their external surface is divided into two portions, by a middle ridge; the posterior portion forms part of the orbit; and the anterior, which is very concave, forms part of the fossa, and canal, for containing the lacrymal sac and duct. This portion is perforated by many small foramina; and the whole, being extremely thin and brittle, is therefore often destroyed by the preparation of the subject. The internal surface of this bone is generally in contact with the cells of the ethmoid; a small portion of the anterior parts is in the general cavity of the nose. Each os unguis is joined above to the frontal bone; behind to the os planum; before and below to the maxillary bone. It sometimes is extended into the nose, as low as the upper edge of the inferior spongy bone.

Ossa Malarum.

The *ossa malarum* are the prominent square bones which form the cheek, on each side. Before, their surface is convex and smooth; backward, it is unequal and concave, for lodging part of the temporal muscles.

The four angles of each of these bones have been reckoned as processes. The one at the external can-

thus of the orbit, called the *superior orbitar* process, is the longest and thickest. The second terminates near the middle of the lower edge of the orbit in a sharp point, and is named the *inferior orbitar* process. The third, placed near the lower part of the cheek, and thence called *maxillary*, is the shortest and nearest to a right angle. The fourth, which is called *zygomatic*, because it is extended backwards to the *zygoma* of the temporal bone, ends in a point, and has one side straight and the other sloping. Between the two orbitar angles there is a concave arch, which makes about a third of the external circumference of the orbit, from which a fifth process is extended backwards within the orbit, to form near one-sixth of that cavity; and hence it may be called the *internal orbitar* process. From the lower edge of each of the ossa malarum, which is between the maxillary and zygomatic processes, the masseter muscle takes its origin.

On the external surface of each cheek-bone, one or more small *holes* are commonly found, for the transmission of small nerves or blood vessels from, and sometimes into, the orbit. On the internal surface are the holes for the passage of the nutritious vessels of these bones. A notch, on the outside of the internal orbitar process of each of these bones, assists to form the great slit common to this bone, and to the sphenoid, maxillary, and palate bones.

The substance of these bones is, in proportion to their bulk, thick, hard, and solid, with some cancelli.

Each of the ossa mallarum is *joined*, by its superior and internal orbitar processes, to the os frontis, and the orbitar process of the sphenoid bone; by the edge between the internal and inferior orbitar processes, to the maxillary bone; by the side between the maxillary and inferior orbitar process, again to the maxil-

lary bone; and by the zygomatic process to the os temporis.

Ossa Palati.

The *ossa palati* form the back part of the roof of the mouth, and extend from it along the external sides of the posterior openings of the nose, into the orbits of the eyes. Each bone may therefore be divided into four parts, the *palate square-bone*, the *pterygoid process*, the *nasal lamella*, and *orbitar process.*

The *square-bone* is irregularly concave, for enlarging both the mouth and cavity of the nose. The upper part of its internal edge rises in a spine, after the same manner as the palate-plate of the maxillary bone does, to be joined with the vomer. Its anterior edge is unequally ragged, for its firmer connexion with the palate-process of the os maxillare. The internal edge is thicker than the rest, and of an equal surface, for its conjunction with its fellow of the other side. Behind, this bone is somewhat in form of a crescent, and thick, for the firm connexion of the velum pendulum palati; the internal point being extended backwards, to afford origin to the palato-staphylinus or azygos muscle. This square bone is well distinguished from the pterygoid process by a perpendicular fossa, which, applied to such another in the maxillary bone, forms a passage for the palatine branch of the fifth pair of nerves; and by another small hole behind this, through which a twig of the same nerve passes.

The *pterygoid process* is somewhat triangular, having a broad base, and ending smaller above. The back part of this process has three fossæ formed in it; the two lateral receive the ends of the two pterygoid plates of the sphenoid bone; the middle fossa, which is very superficial, makes up a part of what is commonly called the *fossa pterygoidea.* The foreside

of this pterygoid process is rough and irregular where it joins the back part of the great tuberosity of the maxillary bone. Frequently several small holes may be observed in this triangular process, particularly one near the middle of its base, which a little above communicates with the common and proper holes of this bone already mentioned.

The *nasal lamella* of this bone is extremely thin and brittle, and rises upwards from the upper side of the external edge of the square bone, and from the narrow extremity of the pterygoid process, it is so weak, and at the same time so firmly fixed to the maxillary bone, as to be very liable to be broken in separating the bones. From the part where the plate rises, it runs up broad on the inside of the tuberosity of the maxillary bone, to form a considerable share of the sides of the maxillary sinus, and to close up the space between the sphenoid and the great bulge of the maxillary bone, where there would otherwise be a large slit opening into the nostrils. On the middle of the internal side of this thin plate, there is a transverse ridge, continued from one which is similar to it in the maxillary bone for supporting the back part of the os spongiosum inferius. Along the outside of this plate, the perpendicular fossa made by the palate-nerve is observable.

At the upper and postesior edge of this nasal plate is a notch, which when applied to the sphenoid bone, forms the spheno-palatine foramen, through which a nerve, artery and vein pass to the nostril; this notch forms two processes on the posterior part of the bone, the inferior of which is in contact with the internal plate of the pterygoid process of the sphenoidal bone, and has therefore been called by some French anatomists, the *pterygoid apophysis of the os palati.* The superior and anterior portion is the proper *orbitar process* of this bone, which is situated

at the posterior part of the lower surface of the orbit, and forms a portion of it. This process of the os palati is hollow; and its cavity generally communicates with the contiguous cell of the os ethmoides. It has several surfaces, one of which is to be found in the orbit, and another in the zygomatic fossa.

The palate square part of the palate bone, and its pterygoid process, are firm and strong, with some cancelli; but the nasal plate, and orbitar processes, are very thin and brittle.

The palate bones are *joined* to the maxillary, by the fore edges of the palate square bones; by their thin nasal plates, and part of their orbitar processes, to the same bones; by their pterygoid processes, and back part of the nasal plates, to the pterygoid processes of the os sphenoides; by the transverse ridges of their nasal lamellæ to the ossa turbinata inferiora, and by the spines of the square bones to the vomer.

The Ossa Spongiosa, or Turbinata Inferiora.

The *ossa spongiosa*, or *Turbinata Inferiora*, are so named to distinguish them from the upper spongy bones, which belong to the os ethmoides; but these lower spongy bones are quite distinct, and connected in a very slight way with the upper jaw-bones. They are rolled or convoluted, very spongy, and exceedingly light. Each of them is attached to the os maxillare superius, near the transverse ridge, by a hook-like process, and covers a part of the opening of the maxillary sinus. One end is turned towards the anterior opening of the nose, and covers the end of the lachrymal duct; the other end of the same bone points backwards towards the throat. The curling plate hangs down into the cavity of the nostril, with its convex side towards the septum. This spongy bone differs from the spongy process of the ethmoid

bone, in being less turbinated or complex, and in having no cells connected with it.

The Vomer.

The *vomer* is a thin flat bone, which forms the back part of the septum of the nose. Its posterior edge extends downwards from the body of the os sphenoides to the palatine processes of the ossa palati, separating the posterior nares from each other.

The figure of this bone is an irregular rhomboid. Its sides are smooth; and its posterior edge appears in an oblique direction at the back part of the nostrils. The upper edge is firmly united to the base of the sphenoid bone, and to the nasal plate of the ethmoid. It is hollow for receiving the processus azygos of the sphenoid, and where it is articulated to the nasal plate of the ethmoid, it is composed of two lamina which receive this plate between them. The anterior edge has a long furrow in it, where the middle cartilage of the nose enters. The lower edge is firmly united to the nasal spines of the maxillary and palate bone. These edges of the bone are much thicker than its middle, which is as thin as paper; in consequence of which, and of the firm union or connexion this bone has above and below, it can very seldom be separated entire in adults; but in a child it is much more easily separated entire, and its structure is more distinctly seen.

Its situation is not always perpendicular, but often inclined and bent to one side, as well as the nasal plate of the ethmoid bone.

It is united above to the os phenoides and the nasal plate of the ethmoid bone; before, to the middle cartilage of the nose; and below, to the ossa palati and ossa maxillaria superiora.

Maxilla Inferior, or Lower Jaw.

The form and situation of this bone are so gene-

rally known, that they do not require description. To acquire an accurate idea of the lower jaw, it is, however, necessary to examine attentively its different parts: viz. the *chin*, the *sides*, the *angles*, and the *processes.*

In subjects where the bones are strongly marked, there is a prominent vertical ridge in the middle and most interior part of the *chin*, which becomes broad below so as to form a triangle, and on each side of this triangular prominence are transverse ridges; from these eminences the muscles of the lower lip originate.

On each side of the jaw, commonly under the second of the bicuspides, or small moler teeth, is the anterior maxillary foramen, through which pass out the remains of the inferior maxillary nerve and blood vessels. This foramen has a direction upward and backward. At a small distance behind these foramina, on each side, is the commencement of a ridge which continues backward until it forms the edge of the *anterior* or *coronoid process.* The *alveolar processes*, which form the upper edge of the jaw, are on the inside of this ridge; the alveoli or sockets corresponding with the roots of the teeth, in number and form. The lower edge of the jaw, which is denominated the *base*, is round and firm, except at the angles, where it is thin.

The *angle* is formed at the posterior extremity of the *base:* in children it is obtuse; but in adults, whose teeth are perfect, it is nearly rectangular. The masseter muscle is inserted into the lower jaw, at the *angle;* and there are several inequalities on the surface made by this muscle.

The *anterior* or *coronoid process*, is rather higher than the *posterior*, and forms an obtuse point; into this process the temporal muscle is inserted. The anterior edge of the *coronoid process* is sharp, and

continued into the ridge above mentioned: from this edge the buccinator muscle arises. As the alveoli are on the inside of this edge and ridge, the jaw is very thick at this place. There is a semicircular notch between this process and the posterior, or *condyloid;* and here the bone is very thin.

The *condyles* are oblong, and are placed *obliquely*; so that their longest axes, if extended until they intersected each other, would form an angle of more than one hundred and forty degrees. The neck of the process, or the part immediately below the condyle, is concave on the anterior, and convex on the posterior surface.

On the inside of the jaw, in the middle of the chin, is a small protuberance, sometimes divided by a verticle fissure; to this are attached the frænum linguæ, and some muscles of the tongue and os hyoides. Further back is a ridge which extends backwards and upwards, until it approaches the alveoli of the last molar teeth, where it terminates in an oblong protuberance. To the anterior part of this line the mylo-hyoidei muscles are attached; and to the posterior extremity, the superior constrictor of the pharynx. The surface of the bone above this ridge is smooth, and covered with the gums and lining membrane of the mouth. The surface below the posterior part of the line is rather concave, to accommodate the submaxillary gland.

At a small distance behind the alveoli, and nearly on a line with them, midway between the roots of the two processes, is a *large foramen* for transmitting the third, or inferior maxillary branch of the fifth pair of nerves, and the blood vessels which accompany it; the canal, which commences here, terminates at the anterior foramen, already described. The surface of this canal is perforated by many foramina, through which blood vessels and nerves pass to the

different teeth, and to the cancelli of the bone. On the *anterior side* of the foramen is a sharp-pointed process, from which a ligament passes to the temporal bone. The nerve and vessels, before they enter into this foramen, make an impression on the bone; and there is generally a small superficial groove which proceeds downwards from it, being made by a small nerve which supplies some of the parts under the tongue.

At the angle of the jaw, on the inside, is a remarkable roughness, where the internal pterygoid muscle is inserted.

The lower jaw moves like a hinge, upon its condyles in the glenoid cavity, when the mouth opens and shuts in the ordinary way. When the mouth is opened very wide, the condyles move forward upon the tubercles before the cavities: if the effort to open the mouth is continued, the lower jaw is fixed in that situation, and the whole head is thrown back, which separates the upper jaw still further from the lower.

The lower jaw can be projected forward without opening the mouth, by the movement of both condyles, at the same time, on the tubercles.

This bone can also rotate upon one condyle, as a centre, while the other moves out of the glenoid cavity, upon the tubercle: but these important motions can be better understood, after the muscles, and the articulation with the temporal bone, in its recent state, have been described.

Of the Teeth.

In the adult, when the teeth are perfect, there are sixteen in each jaw, and those in corresponding situations, on the opposite sides, resemble each other exactly.

They are of four kinds, viz. *incisores*, or the fore

teeth; *cuspidati*, or the canine; *bicuspides*, or the small grinders; and *molares*, or the large grinders.

On each side of the jaw, supposing it divided in the middle, there are *two incisores, one cuspidatus, two biscupides*, and *three molares.* They occur in the order in which they have been named, beginning at the middle of the jaw.

Each tooth is divided into two parts, viz. the *body* or that portion which is bare, and projects beyond the alveoli and gums; and the *root*, which is lodged in the socket. The boundary between these parts, which is embraced by the gum, is called the neck of the tooth.

The *body* and *roots* consist of bone, which is more firm and hard than the substance of the other bones; but all the surface of the body, which projects beyond the gums, is covered with *enamel*, a substance very different from common bone.

Every tooth in its natural condition has a cavity in it, which commences at the extremity of each root, and extends from it to the body of the tooth, where it enlarges considerably. This cavity is lined by a membrane, and contains a nerve, with an artery and vein, which originally entered the tooth, by a foramen near the point of the root, as is evident during the growth of the teeth. These vessels, and the nerve, have been traced into the teeth, although in many subjects the foramina appear to be closed up.

The *alveoli* or *sockets of the teeth*, are formed upon the edge of the jaw: the bone, of which they consist, is less firm than any other part of the jaws: they correspond exactly with the roots of the teeth; and are lined with a vascular membrane which serves as a periosteum to the roots, and assists in fixing them firmly.

The teeth of different kinds differ greatly from each other, in form and size.

The *body of the incisores is broad*, with two flat surfaces, one anterior and the other posterior; the anterior surface is rather convex, and the posterior concave; they meet in a sharp cutting edge. At this edge the tooth is thinnest and broadest; it gradually becomes thicker and narrower, as it is nearer the neck. The enamel continues further down, on the anterior and posterior surfaces than on the sides.

The *incisores* of the upper jaw are broader than those of the lower; especially the two internal incisores.

The *cuspidati* are longer than any other teeth, and are thicker than the incisores. Their edges are not broad, as those of the incisores, but pointed; this point is much worn away in the progress of life. The enamel covers more of the lateral part of these teeth than of the incisores.

The *bicuspides* are next to the *cuspidati*, two on each side. They resemble each other strongly; but the first is smaller than the other, although it generally has a longer root. The bodies are flattened laterally, but incline to a roundish form. On the middle of the grinding surface are depressions which make the edges prominent. On the external edge there is generally one distinct point in each of the *bicuspides*. The internal edge is lower than the external in the first *bicuspis*, which gives it a resemblance to the *cuspidatus*. In the *second bicuspis*, the internal edge, is more elevated, although the point is not so distinct as it is on the external edge.

The *bicuspides* have generally but one root, which is often indented lengthwise, so as to resemble two roots united.

The *three molares*, or *large grinders*, are placed behind the bicuspides, on each side. The first and second strongly resemble each other, but the third has several peculiarities. The body of the large

grinders is rather square; the grinding surface has often five points, and three of these are on the external side. In the upper jaw these teeth have three roots, two situated externally, and one internally, which is very oblique in its direction; they are all conical in their form. It seems probable that the roots of these teeth are arranged in this way to avoid the antrum maxillare. The molares of the lower jaw have but two roots, which are flat, and are placed, one anterior, and the other posterior; in each of these broad roots there are two canals, leading to the central cavity; whereas, in the root of the upper molares there is but one. The third grinder is called *dens sapientiæ*, from its late appearance. It is shorter and smaller than the others; its body is rather rounder, and its roots are not so regular and distinct; for they are sometimes compressed together, and sometimes there appears to have been but one root originally, when the whole tooth has a conical appearance. In some cases the dentes sapientiæ take an irregular direction and shoot against the adjoining teeth.

Infants have a set of deciduous teeth, which differ in several respects from those of adults. They are but *twenty* in number; the five on each side of each jaw, consist of two incisores, one cuspidatus, and two molares or large grinders. The first of them generally protrudes through the gums between the fourth and eighth months of age; the last, about the end of the second year. They commonly appear in pairs,* which succeed each other at irregular intervals. Those of the lower jaw are, in most cases, the first. The order of their appearance is this: the central incisores are first, then the external incisores on each side; after these the first molaris, then the

* The two teeth of a pair do not appear at the same precise time, but very near to each other.

cuspidatus, and finally the last molaris on each side. There are many deviations from this order of succession, but it takes place in a majority of cases.

These deciduous teeth become loose, and are succeeded by those which are more permanent, nearly in the same order in which they appeared, but with a progress much more slow. The incisores generally become loose between the sixth and seventh year; the first molares about the ninth; the cuspidati and the second molares not until the tenth or twelfth, or even fourteenth year. The bicuspides take the places of the infant molares.

The three permanent molares appear in the following order: The first of them protrudes a short time before the front teeth are shed; it is the first of the permanent teeth which appears, and is seen between the sixth and seventh year. The second molaris appears soon after the cuspidati and the second bicuspides are seen. There is then a long interval; for the last molaris or dens sapientiæ is seldom seen before the twentieth year, and sometimes not until the twenty-fifth.

The teeth are formed upon pulpy substances, which are situated in the alveoli, and are contained in capsules. A shell of bone is first formed upon the surface of the pulp, which gradually increases and the pulp diminishes within it. The body of the tooth is produced first, and the root is formed gradually afterwards; during its formation the root has a large opening at the extremity, which is gradually diminished to the small orifice before described. The roots, as well as the body, are formed upon the pulpy substance, which gradually diminishes, as they increase. After the external surface of the body of the tooth is formed, the enamel begins to appear upon it, and gradually increases, until it is completely invested. It is probable that the enamel is deposited up-

on the body of the tooth by the membranous capsule which contains it. This substance, which appears to be formed of radiated fibres, is harder and less destructible than bone. Like the substance of bone, it is composed of phosphate, with a small proportion of the carbonate of lime; but it is destitute of the cartilaginous or membranous structure which is demonstrable in bone.

The pulpy substances, or rudiments of teeth, may be seen in the fœtus, when about four months old. At six months, ossification can be seen to have commenced on the pulps of the incisores. At the time of birth, the *bodies* of the infant teeth are distinctly formed. The alveoli, at first, have the appearance of grooves in the jaw, which afterwards are divided by transverse partitions; they enlarge, in conformity to the growth of the teeth, and appear to be altogether influenced by them.

The permanent teeth are formed very early; the rudiments of the first permanent grinder on each side have commenced their ossification at birth. At the same time, the rudiments of the permanent incisores are to be perceived; and their bodies will be found, nearly ossified, by the time the infant incisores are protruded completely through the gums. About the age of six years, if none of the infant teeth are shed, there will be forty-eight teeth in the two jaws, viz. the twenty infant, and twenty-eight permanent teeth, more or less completely formed.

Os Hyoides.

The *os hyoides* is a small insulated bone, supported between the lower jaw and the larynx, by muscles and ligaments, which proceed from the neighbouring parts in various directions.

The figure of this bone, as its name imports, resembles the Greek letter *υ*. In its natural situation,

the central and convex part is anterior, and the lateral portions extend backwards.

The central part is called the *body*, and the lateral portions the *cornua*.

The *body* is broad, and its upper edge bent inwards; so that the external surface is convex, vertically, as well as horizontally. On this surface is a horizontal ridge: the muscles which proceed from the lower jaw are generally inserted above this ridge, and the muscles from the sternum and scapula below it.

The internal or posterior surface of the body is very concave.

The *cornua*, in young subjects, are distinct from the body of the bone, and joined to it by cartilages: near the body of the os hyoides they are flat; but their figure soon changes, and they terminate on each side in a small tubercle.

On the upper edge of the bone, where the cornua unite to the body, is a process, equal in size to a small grain of wheat, which has a direction upwards and backwards; this is called the *appendix*, or lesser cornu of the os hyoides; from it proceeds a ligament which is attached to the styloid process of the temporal bone, and is sometimes ossified.

The basis of the tongue is attached to the os hyoides, and the motions of the bone have a particular reference to those of that organ; but they will be better understood when the parts with which it is connected have been described.

An acquaintance with the individual bones which compose the head is principally useful, as it leads to a perfect understanding of the whole structure, of which each bone is but a small part.

This structure comprises the cavities which contain the brain and the most important organs of sense, as well as the for-

mina subservient to them, which are of so much importance in the practice of medicine and surgery, and also in physiology, that the following descriptions are subjoined.

Orbit of the Eye.

The figure of this cavity is that of a quadrangular pyramid with its angles rounded; so that it resembles a cone, the bottom being the apex and the orifice the base.

The diameter of the cavity passes obliquely outward from the apex behind. As the figure is irregular, the side next the nose does not partake of this general obliquity, but extends in a straight direction from behind forwards.

The orbit is somewhat contracted at its orifice, and enlarged immediately within. The form of the orifice is rather oval; as the transverse diameter is longer than the vertical. Seven bones are concerned in the formation of this cavity: the os frontis and a portion of the lesser wing of the sphenoid bone above; the os planum or ethmoid, the os unguis, and the nasal process of the upper maxillary bone, and the os palati below: the os malæ, and orbitar plate of the sphenoid bone, on the outside.

On the *upper surface* is the depression for the lachrymal gland; and at the orifice is the notch or foramen for the supra-orbitary vessels, &c. which have already been mentioned.

On the *inner surface* are two longitudinal sutures, which connect the os planum and the os unguis, to the os frontis above, and the os maxillare below. In the upper suture are the two internal orbitary foramina mentioned in the description of the os frontis, the anterior of which transmits a fibre of the ophthalmic nerve, with an artery and vein; the posterior transmits only an artery and vein. There are also two smaller vertical sutures on each side of the os unguis. On the anterior part of this inner surface is

the ridge of the os unguis, and the groove for accommodating the lachrymal sac, which passes into the canal of the same immediately below.

On the *lower surface* is the aforesaid canal, formed by the nasal and orbitar processes of the upper maxillary bone, and that part of the os unguis which is anterior to the ridge. On the posterior part of this surface is a groove which proceeds forwards, and penetrating into the bone becomes a canal that terminates in the infra-orbitar foramen; this groove in the bone is made a canal by the periosteum. The thin plate which forms this surface is the partition between the antrum maxillare and the orbit of the eye, and is more or less absorbed in those cases where polypi of the antrum maxillare occasion a protrusion of the eye.

The *external surface*, formed by the malar bone and the orbitar plate of the sphenoid, is almost flat. In the posterior part of the orbit it is bounded by two large fissures, which are now to be described.

In the posterior part of the orbit are three apertures. The optic foramen, the sphenoidal fissure, and the spheno-maxillary fissure.

The optic foramen opens almost at the bottom of the orbit on the inside; its direction is forwards and outwards.

The sphenoidal fissure, formed principally by the lesser and greater wings of the sphenoidal bone, begins at the bottom of the orbit, and extends forward, upward, and outward. It is broad at the commencement and gradually diminishes to a fissure. This fissure opens directly into the cavity of the cranium, and admits the third, fourth, sixth, and one branch of the fifth pair of nerves, an artery and a vein.

The spheno-maxillary fissure commences also at the bottom of the orbit, and extends forward, out-

ward, and downward, between the maxillary bone and the orbitar plate of the sphenoid, from the body of the sphenoid to the malar bone. This fissure opens from the orbit directly into the zygomatic fossa. In the recent subject it is closed, and only transmits the infra-orbitary nerve and vessels, and a small branch of the superior maxillary nerve.

The Cavities of the Nose.

These cavities, which are separated from each other by the septum narium, are contained between the cribriform plate of the ethmoid and the palatine processes of the upper maxillary and palate bones, and between the anterior and posterior nares. They are therefore of considerable extent in these directions; but the distance from the septum to the opposite side of the nose is so small, that each cavity is very narrow.

The upper surface of each cavity consists of that portion of the cribriform plate of the ethmoid which is between the septum and the cellular portions. Anterior to this, each cavity is bounded by the *internal surface* of the *os nasi* of its respective side; and posterior to it, by *the anterior surface of the body of the sphenoid bone.* These anterior and posterior surfaces form obtuse angles with the upper surface of the nose, and are immediately above the openings called anterior and posterior nares. The *anterior surface* partakes of the figure of the os nasi; the *upper surface* has the perforations of the cribriform plate; the *posterior surface* has an opening, equal in diameter to a small quill, that leads into the sphenoidal cell, and it is also broader than the anterior or superior surface.

The *internal surface*, formed by the septum of the nose, which is composed of the vomer, the nasal plate of the ethmoid, and cartilaginous plate, is

flat, but rather inclined to one side or the other, so as to make a difference in the nasal cavities.

The *external surface* is very irregular; it is formed by the *cellular portions* of the *ethmoid;* by a small portion of the *os unguis*; by the *upper maxillary bone;* the *os turbinatum inferius;* the *os palati;* and the *internal pterygoid process* of the *os sphenoides.* The upper part of this surface is formed by the internal surface of the cellular portions of the ethmoid, which have been described at page 32. It extends from the sphenoid bone, very near to the ossa nasi; and is uniformly flat and rough.

About the middle of it begins a deep groove, which penetrates into the cellular structure of the ethmoides, and passes obliquely downwards and backwards. At the upper end of this groove is the foramen by which the posterior ethmoidal cells communicate with the nasal cavity.

This is the *upper channel* or *meatus* of the nose. At the posterior end of it is a large foramen formed by the nasal plate of the os palati and the pterygoid process of the os. sphenoides, and therefore called *pterygo or spheno palatine* foramen. It opens externally and transmits a nerve and an artery to the nose.

Below the meatus is the upper spongy bone, which presents a convex surface; its lower edge is rolled up and not connected with the parts about it. This spongy bone covers a foramen in the ethmoid bone, by which its anterior cells and the frontal sinuses communicate with the nose.

Below this spongy bone, is the *middle channel* or *meatus* of the nose. This *channel* extends from the anterior to the posterior part of the cavity. It is very deep, as it penetrates to the maxillary bone. The cells of the ethmoid are above it; the inferior turbinated bone below it; and the upper spongy bone projects over it. In this channel is the *opening of the*

great cavity of the upper maxillary bone. At the anterior extremity of it is a small portion of the *os unguis*, which intervenes between the nasal process of the upper maxillary bone and the cells of the ethmoid, and continues down to the lower spongy bone.

The *lower spongy bone* is nearly horizontal, and very conspicuous. It extends almost from one opening of the nose to the other.

Under this bone is the *third and largest channel* or *meatus* of the nose. It is made large by an excavation of the upper maxillary bone, particularly at the anterior part. It affords a direct and very easy passage to the posterior opening of the nose and the throat.

Near the anterior extremity of this meatus is the lower orifice of the lachrymal duct, which is so situated that a probe properly curved can be readily passed into it through the nostril.

There are then four foramina on each side, which form communications between the cavities of the nose and the adjacent cells, viz.

One in the upper meatus which leads to the posterior ethmoid cells.

A second in the middle meatus which leads to the anterior ethmoid cells and the frontal sinuses.

A third in the same meatus which opens into the maxillary sinus.

A fourth in the anterior surface of the body of the sphenoidal bone, which opens into the sphenoidal sinus.

To these must be added the opening of the lachrymal canal.

It will be useful to the student of anatomy, after placing three or four of the uppermost cervical vertebræ in their natural situation to take a view of

The Cavity between the spine and the posterior Nares, which is bounded, *above*, by the cuneiform process, passing obliquely upward and forward; *laterally*,

by soft parts not yet described; *behind*, by the bodies of the cervical vertebræ; and *before*, by the posterior nares, each of which is oblong in form, rounded above, flat below, and separated from the other by a thin partition, the vomer.

The cavity of the Cranium.

The upper concave surface of this cavity corresponds with the figure of the cranium. The ridge in it for supporting the falciform process of the dura mater, the groove made by the longitudinal sinus, the impressions of the arteries, and the pits made by the convolutions of the brain, are particularly to be noticed.

The Basis of the Cranium.

is much more important. It is divided into three fossæ on each side: the anterior of these are most superficial, and the posterior the deepest. The bottoms of the *anterior fossæ* are formed by the *orbitar processes* of the *os frontis*, and consequently are convex; between them is the *cribriform plate* of the *ethmoid*, which is commonly sunk below the adjoining surface. The *crista galli* is very conspicuous; and the foramen cæcum can almost always be seen. The crista galli is evidently the beginning of the prominent ridge, which continues on the os frontis, and supports the falx of the dura mater. The posterior margins of these fossæ are formed by the lesser wings of the sphenoid bone.

The *middle fossæ* are formed by the great wings of the sphenoidal bone, and by the squamous and petrous portions of the temporal bone. They are lower than the anterior, and higher than the posterior fossæ. The projection of the margin of the anterior fossæ into these cavities, corresponds with the separation between the anterior and middle lobes of the

brain. The suture between the sphenoidal and temporal bones is evident in these fossæ. The upper surface of the body of the sphenoid bone, or the sella turcica is between them; and all the peculiarities of its surface are very conspicuous. The first five foramina of the sphenoidal bone can be easily ascertained, and also, the anterior foramen lacerum and termination of the foramen caroticum, with the impressions made by the carotid arteries on the sides of the sella turcica. The petrous portions of the temporal bones are the posterior boundaries of the middle fossæ. Their oblique direction, inwards and forwards, is particularly remarkable; being formed like triangular pyramids. Two of their sides are in the cavity of the cranium; one, which is anterior, forms a portion of the middle fossa; and the other forms a part of the posterior fossa. The edge between them is very prominent, and has the tentorium or horizontal process of the dura mater attached to it. On the anterior surface, in the middle fossa, may be traced the groove, and the foramen for the vidian nerve.

The posterior fossæ are larger as well as deeper than the other two. Their boundaries are well defined by the edges of the petrous bones above mentioned, and by the grooves of the horizontal parts of the lateral sinuses. These fossæ are nearly separated from the general cavity by the tentorium, which is attached to the edge of the petrous bone and also to the edge of the horizontal part of the groove for the lateral sinuses. On the tentorium lie the posterior lobes of the cerebrum; and under it, in these fossæ, is the cerebellum.

These fossæ may be considered as one great cavity, which is circular behind, and somewhat angular before. The angular surfaces are formed by the posterior sides of the petrous portions. Between them,

is the oblique surface of the cuneiform process of the occipital bone, which descends to the great foramen. On the surface of each petrous bone is the meatus auditorius internus, and the orifice of the aqueduct of the vestibule. Behind the petrous portion, the groove for the lateral sinus is very conspicuous; it terminates in the posterior foramen lacerum, which is evidently formed by the temporal and the occipital bones. At the anterior part of this foramen is most commonly a small bony process, which separates the eighth pair of nerves from the internal jugular vein, as they pass out here.

The anterior condyloid foramen for the passage of the ninth pair of nerves, appears in the surface of the great occipital hole, immediately below the foramen lacerum. From the back part of this hole the spine, which forms the lower limb of the cross, passes up; and on each side of it are the great depressions which accommodate the two lobes of the cerebellum.

External Basis of the Cranium.

When the head is inverted, we see the external protuberances of the os occipitis, formerly described. The mastoid processes of the ossa temporum are on the same transverse line with the great foramen of the os occipitis; but the foramen being larger extends farther forward. On the inside of the mastoid process, the fissure for the digastric muscle is very conspicuous, and also the suture between the mastoid process and the occipital bone.

The oblique direction of the occipital condyles and the slanting position of their articulating surfaces are particularly striking. The posterior condyloid foramina for the cervical veins, and the anterior for the ninth pair of nerves, are also in view. The position of the cuneiform process of the os occipitis is by no means horizontal, but extends forwards and

upwards. The *petrous* or *pyramdidal portion* of the temporal bone commences between the mastoid process, and the condyle of the lower jaw, and extends *obliquely forwards* and *inwards*, having the occipital bone behind it, and the glenoid cavity and the os sphenoides before it. At the commencement, the surface of the petrous portion is not horizontal but oblique, sloping into the glenoid cavity with a sharp edge downwards. This edge in some cases is curved so as to surround the basis of the styloid process, which arises in contact with it, and projects downwards, on each side of the vertebræ. Between the mastoid and styloid process, is the foramen stylo-mastoideum. On the inside of the styloid process, and rather anterior to it, is the foramen lacerum posterius, for the internal jugular vein, the eighth pair of nerves, &c. This foramen passes obliquely backwards and upwards, and is bounded behind by the jugular process of the os ocipitis, which bone seems to contribute most to its formation. Very near to this hole on the inside, is the anterior condyloid foramen; and rather anterior to it is the opening of the carotid canal, which forms a curve in the bone as it passes upwards, inwards, and forwards.

From the foramen lacerum posterius, the suture, between the cuneiform process of the occipital and the petrous portion of the temporal bone, extends to the foramen lacerum anterius; which is closed by cartilage in the recent subject, but is of an irregular and rather triangular form in the macerated head; this hole is formed by the occipital, sphenoidal and petrous bones. The suture or connexion between the petrous bone and the os sphenoides, is continued on the anterior side of the petrous bone, from the fissure of the glenoid cavity to the anterior foramen lacerum. The styloid process of the os sphenoides, which is seldom more than four lines in length, appears at

the edge of this suture. On the inside of the glenoid cavity, and on the inside of this process, in the suture formed between the petrous and sphenoid bones, is the bony orifice of the *eustachian* tube.

The foramen spinale for the middle artery of the dura mater is at a very small distance from the eustachian tube, immediately anterior to it; and at a small distance on the inside and front of this foramen, is the foramen ovale, for the inferior maxillary nerve, or the third branch of the fifth pair.

Side of the Head.

Those portions of the side of the head which are formed by the frontal, parietal and occipital bones, and by the squamous part of the temporal, require no explanation here; but *the region* which is behind the *malar* and *upper maxillary* bone, and within the *zygomatic processes* of the *temporal* and *malar* bones, which comprises part of the temporal and zygomatic fossæ of some anatomists, is both important and obscure.

To obtain a view of this, the lower jaw should be removed, and the zygoma sawed away, in one preparation; and in another, the upper maxillary and palate bones, of one side, should be applied in their natural position, to the os sphenoides, without any of the other bones.

The upper part of this region, formed by the sphenoidal, frontal and malar bones, is made concave by the form of the external angular part of the os frontis and of the os malæ; which projects backwards so as to cover a large portion of it.

The lower part is formed principally by the external surface of the pterygoid process of the sphenoid bone, and by the posterior surface of the upper maxillary. Between the lower end of the pterygoid process and the upper maxillary bone, a small por-

tion of the os palati intervenes; but in many adult subjects it is not to be distinguished from the other bones. At this place, the pterygoid process and these bones appear to be in close contact; but as they pass upwards they recede from each other so as to form a considerable aperture, which continues the whole length of the pterygoid process. This *fissure*, which may be called *pterygo palatine* or *pterygo maxillary*, would open into the posterior part of the cavity of the nose, if the nasal plate of the os palati did not intervene; this plate forms a partition, which separates the nose from this fissure; and the spheno-palatine foramen, formed principally by it, transmits a nerve and blood vessels to the nose.

The fissure is vertical: at the back of the orbit, it unites with the spheno-maxillary fissure of the orbit, which is almost horizontal; and at the place of their junction, the sphenoidal, or upper fissure of the orbit, opens also.

The foramen rotundum, which transmits the second branch of the fifth pair, or the upper maxillary nerve, is likewise situated near this place; and when the upper maxillary, the sphenoidal, and the palate bones are in their natural situation, the distribution of the branches of this important nerve can be easily understood: for the same view presents the course of its various branches; viz. to the nose, by the spheno palatine foramen; to the cavity of the cranium, by the pterygoid foramen; to the orbit, and the inferior orbitary canal, by the spheno-maxillary fissure; and to the roof of the mouth, by the palato-maxillary canal.

The form of the Cranium.

The *form* of the *cranium* is that of an irregular oval. The *greatest length* of its cavity is between

a part of the os frontis above the crista galli, and of the os occipitis above the centre of the crucial ridge

The *greatest breadth* is at about two-thirds of the distance from the first to the last of these positions. This transverse diameter touches the sides of the cranium near the posterior part of the basis of the petrous portion of the temporal bone. The difference between these longitudinal and transverse diameters varies greatly in different persons, as their craniums approach to the oval or round figures.

The *greatest depth* of the cavity is between the posterior part of the cuneiform process of the occipital bone, and a part of the cranium which is nearly over it, about the middle of the sagittal suture.

The figure of the cranium is somewhat varied in different races of men; and it has been much changed by the particular management of several savage nations.

In North America, the Choctaw tribe of Indians were formerly accustomed to make their foreheads perfectly flat, and sloping obliquely backwards. They have latterly disused this practice; but one of their nation, whose head had this form, was in Philadelphia about the year 1796.

At this time a tribe who inhabit a district of country near the sources of the Missouri river, are in the practice of flattening both the frontal and occipital regions of the head; so that a small part only, of the middle of it, remains of the natural form, between these flattened sloping surfaces.

In the case of the Choctaw man above mentioned, it did not appear that his health, or his intellectual operations, were any way affected by this form of his head.

During infancy, the cranium sometimes increases to a preternatural size, as disproportionate to the face as if it were affected by hydrocephalus. In many of

these instances that disease ultimately shows itself; but in other cases, the preternatural increase of the cranium finally stops without the occurrence of disease; and the disproportion is lessened by the increase of the face in the ordinary progress of growth.

In many cases where men have deviated from the ordinary stature, the head has preserved the common size. It is therefore said to be small in giants and large in dwarfs.

The Head of the Fœtus.

In the fœtus, those bones, which form the vault of the cranium, *originally* consist of one plate only; which is composed of radiated fibres.

At birth, the *os frontis* consists of two pieces, which join each other in the middle of the forehead.

The *parietal bones* are each in a single piece; but they are incomplete at their edges and their angles.

The *temporal bones* have no appearance of mastoid or styloid processes. Instead of a meatus auditorius externus, there is a bony ring in which the membrana tympani is fixed. The squamous and petrous portions, and this ring, are originally formed separate; but at the period of birth they often adhere to each other.

The *os occipitis* is composed of four pieces: the first and largest, extends from the beginning or angle of the lambdoidal suture to the upper edge of the great occipital foramen. Each side of the foramen, and the condyle on it, is formed by a distinct piece. The front part is formed by the cuneiform process, which is separate from the other parts and forms the fourth piece.

The *sphenoidal bone* may be separated by maceration into three pieces. The body and the little wings form one piece. Each of the great wings,

with the pterygoid processes united to it, forms also a piece. The body of the bone is entirely solid.

A large part of the *ethmoid* is in a cartilaginous state. It is divided into two portions by a partition of cartilage, which occupies the place of the nasal plate and the crista galli.

In consequence of the imperfect formation of the bones which compose the vault of the cranium, there are several deficiencies in it. Thus the superior anterior angles of the parietal bones being incomplete, and also the upper angles of the pieces which compose the os frontis, a vacuity with four sides is occasioned, which is termed the

Anterior fontanel. This opening may be distinguished by its form, as well as its greater size, from another vacuity which is produced in a similar way at the other end of the sagittal suture, and called the

Posterior fontanel: but as there are only three bones concerned in its formation, viz. the two parietal and the occipital, this vacuity is triangular.

Besides these, there are two other *vacuities* or *fontanels* on each side, at the two lower corners of each parietal bone: these however are much less than those first described.

The *smaller fontanels* do not continue open long; but the anterior fontanel is seldom completely closed before the end of the third year.

It is very obvious, upon an examination of the cranium, that the centre of the base is better calculated to resist pressure than any other part; as the cuneiform process of the occipital bone, the petrous portions of the temporal, and the body of the sphenoidal bone, which compose a large part of it, are very firm and substantial.

The *face of the fœtus* differs very essentially from that of the adult. Although the orbits of the eyes are very large when compared with the size of

the head, that portion of the face which is below them is very small and has little depth.

The upper maxillary bones have no sinuses in them; and their orbitar plates are not much elevated above the cavities for containing the posterior teeth: in consequence, the depth of the face is very small; and its whole aspect is affected.

The *nose* of the *fœtus* differs greatly from that of the adult in respect to its sinuses; for not only are the maxillary cavities wanting, but those of the frontal and sphenoidal bones also.

The *lower jaw* is formed in two pieces, which unite at the middle; and hence the term *symphysis* is used in describing the chin. This bone is not only less broad in proportion than that of the adult, but the angles are more obtuse, and the processes which arise from them are more sloping.

The head of the fœtus is much larger in proportion to the body than that of the adult.

SECTION II.

Of the Trunk.

The *Trunk* consists of the Spine, Thorax, and Pelvis.

The Spine.

The *spine* is the long pile of bones extended from the condyles of the occiput to the end of the os coccygis. It somewhat resembles two unequal pyramids joined in a common base. It is not, however, straight; for its upper part being drawn backwards by strong muscles, it gradually advances forwards, to support the œsophagus, vessels of the head, &c. Then it turns backwards, to make room for the heart and lungs. It is next bent forwards to support the viscera of the abdomen. It afterwards turns back-

wards, for the enlargement of the pelvis. And, lastly, it is reflected forwards, for sustaining the lowest great intestines.

The spine is commonly divided into *true* and *false vertebræ:* the former constituting the long upper pyramid, which has its base below; while the false vertebræ make the shorter lower pyramid, whose base is above.

True Vertebræ.

The *true vertebræ* are the twenty-four upper bones of the spine, on which the several motions of the trunk of our bodies are performed. Their name is derived from the Latin verb *vertere.*

Each of these vertebræ is composed of its body and processes.

The *body* is the thick spongy forepart, which is convex before, concave backwards, horizontal and flat in most of them above and below. Numerous small holes, especially on the fore and back part of their surface, give passage to their vessels, and allow the ligaments to enter their substance. The edges of the body of each vertebra are covered, especially at the forepart, with a ring of bone firmer and more solid than the substance of the body any where else. These rings seem to be joined to vertebræ in the form of epiphyses. They are of great use in preventing the spongy bodies from being broken in the motions of the trunk.

Between the bodies of each two adjoining vertebræ, a substance between the nature of ligament and cartilage is interposed; which seems to consist of concentrical curved fibres, when it is cut horizontally; but when it is divided perpendicularly, the fibres appear oblique and decussating. The outer part of these intervertebral ligaments is the most solid and hard; and they gradually become softer till they are

almost in the form of a glairy liquor in the centre. The external fibrous part of each is capable of being greatly extended, and of being compressed into a smaller space, while the middle fluid part is incompressible, or nearly so. The middle point is therefore a fulcrum or pivot, on which the motion of a ball and socket may be made, with such a gradual yielding of the substance of the ligament, in whatever direction our spines are moved, as saves the body from violent shocks, and their dangerous consequences. This ligamento-cartilaginous substance is firmly fixed to the horizontal surfaces of the bodies of the vertebræ, to connect them; in which it is assisted by a strong membranous ligament, which lines all their concave surface, and by a still stronger ligament that covers all their anterior convex surface.

The elastic substance seems to be in a state of compression by the exterior ligament and the bones; for, if a section be made through a portion of the vertebræ and the intervertebral substance, this substance will expand, so that its surface will be much higher than that of the vertebræ. It is so elastic, and so much confined, in some subjects, that a sharp knife, if plunged into it, will be gradually ejected when the hand is withdrawn.

The bodies of the vertebræ are, with some exceptions, smaller and more solid above, but more spongy as they descend. The cartilages between them are thick, and the surrounding ligaments are strong in proportion to the size of the vertebræ. By this disposition, the greatest weight is supported on the broadest best secured base, and the middle of the body is allowed a large and secure motion.

From each side of the body of each vertebra, a bony bridge is produced backwards, and to one side; from the posterior end of which one slanting process rises and another descends. The smooth, and ge-

nerally the flattest side of each of these four processes is covered with a smooth cartilage; and the two lower processes of each upper vertebra are fitted to, and articulated with, the two upper processes of the vertebra below, having their articular ligaments fixed into the rough line round their edges. These processes are termed the *oblique* or *articulating*.

From between the oblique processes of each side, another process extends laterally, which is called the *transverse*.

From the back part of the roots of the two oblique processes, and of the transverse process of each side, a broad oblique bony plate is extended backwards: where these meet, the seventh process of the vertebræ takes its rise, and stands out backwards. This being generally sharp-pointed and narrow-edged, it has therefore been called *spinal* process; from which this whole chain of bones has got its name.

Besides the common ligament which lines all the internal surface of the spinal processes, as well as of the bodies, particular ligaments connect the bony bridges and processes of the contiguous vertebræ together.

The substance of the processes is considerably stronger and firmer, and has a thicker external plate, than the bodies of the vertebræ themselves.

The seven *processes* form a concavity at their forepart, which, joined to the one at the back part of the bodies, make a great hole; and when the vertebræ are placed upon each other in their natural order, these holes form a long tube for containing the spinal marrow.

In the upper and lower edge of each lateral bridge, there is a notch. These are so adapted to each other in the contiguous vertebræ, as to form a round hole in each side, between each two vertebræ, through

which the nerves proceed from the spinal marrow and its blood vessels pass.

The *articulations* of these true vertabræ are consequently double; for their bodies are joined by the intervening cartilage above described; and their oblique processes, being tipped with cartilages, are so connected by their ligaments as to allow a small degree of motion on every side. Hence it is evident, that their centre of motion is altered in different positions of the trunk: for, when we bow forwards, the weight bears entirely on the bodies of the vertebræ; if we bend back, the oblique processes support it; if we recline to one side, we rest upon the oblique processes of that side and part of the bodies; if we stand erect, all the bodies and oblique processes have their share in our support.

The true vertebræ are divided into three *classes*, which agree with each other in their general structure, but are distinguished by several peculiarities.

These classes are named *Cervical*, *Dorsal*, and *Lumbar.*

The CERVICAL are the seven uppermost vertebræ; which are distinguished from the rest by these marks: Their bodies are smaller and more solid than any others; and are flatted on the front surface. They are also flat behind, where small processes rise, to which the internal ligaments are fixed. The upper surface of the body of each vertebræ is made hollow, by a slanting thin process which is raised on each side. The lower surface is also hollowed, but in a different manner; for here the posterior edge is raised a little, and the anterior one is considerably extended. Hence the cartilages between these vertebræ are firmly connected, and their articulations are secure.

These cartilages are thick, especially at their forepart; which is one reason why the vertebra project forward as they descend, and have the larger motion.

Their *oblique* processes more justly deserve that name than those of any other vertebræ. They are situated slanting; the upper ones having their smooth and almost flat surfaces facing obliquely backwards and upwards; while the inferior oblique processes have these surfaces facing obliquely forwards and downwards.

The *transverse* processes of these vertebræ are framed in a different manner from those of any other bones of the spine: for, besides the common transverse process rising from between the oblique processes of each side, there is a second one that comes out from the side of the body of each vertebra; and these two processes, after leaving a circular hole for the passage of the vertebral artery and vein, unite and form a groove on their upper surface to protect the nerves that pass in it. They terminate obtusely on each side, for the insertion of muscles.

The *spinal* processes project backwards almost horizontally. They are shorter than those of any other vertebræ, and are forked or double at their ends; they therefore allow a more convenient insertion to muscles.

The thick *cartilages* between the bodies of these cervical vertebræ, the obliquity of their oblique processes, and the shortness and horizontal situation of their spiral processes, all conspire to allow them large motion.

The *holes* between the bony cross bridges, for the passage of the nerves from the spinal marrow, have their largest share formed in the lowest of the two vertebræ, to which they are common.

So far most of the cervical vertebræ agree; but they have some particular differences, which require a separate consideration.

The first, from its use in supporting the head, has the name of *atlas*. Contrary to all the other verte-

bræ of the spine, it has no body; but instead of it, there is a bony arch. In the convex forepart of this arch a small rising appears; and on each side of this protuberance, a small cavity may be observed. The upper and lower parts of the arch are rough and unequal, where the ligaments that connect this vertebra to the os occipitis, and to the second vertebra, are fixed. The back part of the arch is concave, smooth, and covered with a cartilage, in a recent subject, to receive the tooth-like process of the second vertebra. On each side of it a small rough sinuosity may be remarked, where the ligaments going to the sides of the tooth-like process of the following vertebra are fastened; and on each side a small rough protuberance and a depression is observable, where the transverse ligament, which secures the tooth-like process in the sinuosity, is fixed, and hinders that process from injuring the medulla spinalis in the flexions of the head.

The atlas has a little spinal process as body; but, instead of it, there is a large bony arch, that the muscles which pass over this vertebra at that place might not be hurt in extending the head. On the posterior and upper part of this arch there are two depressions, where the recti postici minores take their rise; and at the lower part are two other sinuosities, into which the ligaments that connect this bone to the following one are fixed.

The superior oblique processes of the atlas are large, and more horizontal than those of any other vertebra. They form an oblong concave surface which has an internal aspect, and corresponds exactly with the articulating surface on the external side of each condyle of the os occipitis. Under the external edge of the posterior part of each of these cavities is the fossa, or deep open channel, in which the vertebral arteries make the circular turn, as they

are about to enter the great foramen of the occipital bone, and where the tenth pair of nerves go out. In some subjects this fossa is covered with bone. The inferior oblique processes, extending from within outwards and downwards, are large, circular, and slightly concave. So that this vertebra, contrary to the other six, receives the bones with which it is articulated, both above and below.

The transverse processes of this vertebra are not much hollowed or forked; but are longer and larger than those of any other vertebra of the neck, for the origin and insertion of several muscles; and therefore those muscles which move this vertebra on the second have a considerable lever to act with, because of the distance of their insertion from the axis of revolution.

The hole for the medulla spinalis is larger in the atlas than in any other vertebra, not only on account of the medulla being largest here, but also to prevent its being hurt by the motions of this vertebra on the second. This large hole, and the long transverse processes, make this the broadest vertebra of the neck.

The condyles of the os occipitis move forwards and backwards in the superior oblique processes of this vertebra; but from the figure of the bones forming these articulations, it is evident, that very little motion can here be allowed to either side; and there must be still less circular motion.

The second vertebra of the neck is called *dentata.* It is somewhat of a pyramidal figure, being large, and extended downwards, especially in front, to enter into a hollow of the vertebra below; while the upper part has a long process, with its extremity formed into an obtuse point. This process, from its supposed resemblance to a tooth, has given name to the vertebra. The side of it, on which the concave

surface of the anterior arch of the first vertebra plays, is convex, smooth, and covered with a cartilage; and it is of the same form behind, to accommodate the ligament, which is extended transversely from one rough protuberance of the first vertebra to the other, and is cartilaginous in the middle. A ligament likewise goes out in an oblique transverse direction, from each side of the processus dentatus, to be fixed at its other end to the first vertebra, and to the occipital bone; and another ligament rises up from near the point of the process to the os occipitis.

The superior oblique processes of the vertebra dentata are large, circular, very nearly in a horizontal position, and slightly convex, to be adapted to the inferior oblique processes of the first vertebra. The inferior oblique processes of this vertebra answer exactly to the description given of those common to all the cervical vertebræ.

The transverse processes of the vertebra dentata are short, very little hollowed at their upper part, and not forked at their ends; and the canals through which the vertebral arteries pass are reflected outwards about the middle of each process; so that the course of these vessels may be directed towards the transverse processes of the first vertebra. Had this curvature of the arteries been made in a part so moveable as the neck is, while they were not defended by a bone and placed in the cavity of that bone, scarce a motion could have been performed without the utmost hazard of compression. This is the third instance of similar mechanism in cases of sudden curvature of arteries. The first is the passage of the carotids through the temporal bones; and the second is that lately described, where the vertebral arteries turn round the oblique processes of the first vertebra, to come at the great hole of the occipital bone.

The spinal process of this vertebra is thick, strong,

and short, to give sufficient origin to the musculi recti majores and obliqui inferiores, and to prevent the contusion of these and other muscles in pulling the head back.

The four cervical vertebræ which are next in order, have nothing particular in their structure, but agree with the general description. The seventh vertebra approaches the form of those of the back, having the upper and lower surfaces less excavated than the others. The oblique processes are more perpendicular; and the spinal as well as transverse processes are without bifurcation.

After an examination of the condyles of the os occipitis, and of the whole structure of the atlas and vertebra dentata, it will be evident, that the flexion and extension of the head, or its motion backwards and forwards, is effected by the movements of the condyles of the occipital bone on the atlas; and that in the rotation of the head, the atlas revolves to a certain degree round the processus dentatus of the second vertebra: the head necessarily moving with it.

The TWELVE DORSAL may be distinguished from the other *vertebræ* of the spine by the following marks.

Their bodies are of a middle size, between those of the neck and loins. They are more convex before than either of the other two sorts; and are flattened laterally by the pressure of the ribs, which are inserted into small cavities formed in their sides. This flatness of their sides, which makes the figure of these vertebræ almost a half oval, is of great use; as it affords a firm articulation to the ribs, allows the trachea arteria to divide at a small angle, and the other large vessels to run secure from the action of the vital organs. Their bodies are more concave behind than any of the other two classes. The upper and lower surfaces are horizontal.

The cartilages interposed between the bodies of

these vertebræ are thinner than in any other of the true vertebræ; and contribute to the concavity of the spine in the thorax, by being thinnest at their forepart.

The oblique processes are placed almost perpendicularly: the upper ones slanting but a little forwards, and the lower ones slanting as much backwards. The convexity or concavity is not so remarkable as to require particular notice. Between the oblique processes of opposite sides, several sharp processes stand out from the upper and lower parts of the plates which join to form the spinal processes: into these sharp processes strong ligaments are fixed for connecting the vertebræ.

The transverse processes of the dorsal vertebræ are long, thicker at their ends than in the middle, and turned obliquely backwards; which may be owing to the pressure of the ribs; the tubercles of which are inserted into a depression near the end of these processes.

The spinal processes are long, small-pointed, and sloping downwards and backwards. From their upper and back part a ridge rises, which is received by a small channel in the forepart of the spinal process immediately above, which is here connected to it by a ligament.

The canal for the spinal marrow is here more circular, but corresponding to the size of that chord, is smaller than in any of the other vertebræ; and a larger share of the holes, in the bony bridges for the transmission of the nerves, is formed in the vertebra above than in the one below.

The connexion of the dorsal vertebræ to the ribs, the thinness of their cartilages, the erect situation of the oblique processes, the length, sloping, and connexion of the spinal processes, all contribute to restrain these vertebræ from much motion, which

might disturb the actions of the heart and lungs; and in consequence of the little motion allowed here, the intervertebral cartilages sooner shrivel, by becoming more solid; and therefore the first remarkable curvature of the spine observed, as people advance to old age, is in the least stretched vertebræ of the back; or old people first become round-shouldered.

The bodies of the four uppermost dorsal vertebræ deviate from the rule, and the vertebræ become larger as they descend; for the first of the four is the largest, and the other three below gradually become smaller, to allow the trachea and large vessels to divide at smaller angles.

The two uppermost vertebræ of the back, instead of being very prominent forwards, are flattened by the action of the musculi longi colli and recti majores.

The proportional size of the two little depressions in the body of each vertebra for receiving the heads of the ribs, seems to vary in the following manner: the depression on the upper edge of each vertebra decreases as far down as the fourth, and after that increases.

The transverse processes are longer in each lower vertebra to the seventh or eighth, with their smooth surfaces, for the tubercles of the ribs, facing gradually more downwards; but afterwards, as they descend, they become shorter, and the smooth surfaces are directed more upwards.

The spinous processes of the vertebræ of the back become gradually longer and more slanting from the first, as far down as the eighth or ninth vertebra; from which they manifestly turn shorter and more erect.

The first vertebra, besides an oblong hollow in its lower edge, that assists in forming the cavity where-

in the second rib is received, has the whole cavity for the head of the first rib formed in it.

The eleventh often has the whole cavity for the eleventh rib in its body, and wants the smooth surface on each transverse process.

The twelfth always receives the whole head of the last rib, and has no smooth surface on its transverse processes, which are very short. The smooth surfaces of its inferior oblique processes face outwards as the lumbar do. In general the upper vertebræ of the back lose gradually their resemblance to those of the neck, and the lower ones approach gradually to the figure of the lumbar.

The LUMBAR VERTEBRÆ are five bones, that may be distinguished from any others by these marks: 1. Their bodies, though of a circular form at their forepart, are somewhat oblong from one side to the other. The epiphyses on their edges are larger; and therefore the upper and lower surfaces of their bodies are more concave than in the vertebræ of the back. 2. The cartilages between these vertebræ are very thick, and render the spine convex within the abdomen, by their great thickness anteriorly. 3. The oblique processes are strong and deep; the superior, which are concave, facing inwards, and the convex inferior ones facing outwards; and therefore each of these vertebræ receives the one above it, and is received by the one below, which is not so evident in the other two classes already described. 4. Their transverse processes are small, long, and almost horizontal, for allowing large motion to each bone, and sufficient insertion to muscles, and for supporting and defending the internal parts. 5. Between the roots of the superior oblique and transverse processes a small protuberance may be observed, where some of the muscles that raise the trunk of the body are inserted. 6. Their spinal processes are strong, straight,

and horizontal, with broad flat sides, and a narrow edge above and below; this last being depressed on each side by muscles; and at the root of these edges, we see rough surfaces for fixing the ligaments. 7. The medullary canal is larger in these bones than in the dorsal vertebræ. 8. The holes for the passage of the nerves are more equally formed out of both the contiguous vertebræ than in the other classes; the upper one furnishes, however, the larger share of each hole.

The thick cartilages between these lumbar vertebræ, their deep oblique processes, and their erect spinal processes, are all fit for allowing large motion: though it is not so great as what is performed in the neck; which appears from comparing the arches which the head describes when moving on the neck or the loins only.

The lumbar vertebræ, as they descend, have their oblique processes at a great distance from each other, and facing more backwards and forwards.

The transverse and spinal processes of the first and last lumbar vertebræ are shorter than those in the middle.

The epiphyses round the edges of the bodies of the lumbar vertebræ are most raised in the two lowest; which consequently make them appear hollower in the middle than the others are.

The body of the fifth vertebra is rather thinner than that of the fourth. The spinal process of this fifth is smaller, and the oblique processes face more backwards and forwards, than those of any other lumbar vertebra.

In consequence of this particular construction, the spine is capable of flexion, principally in an interior and lateral direction, and also of extension. It ought to be remarked that during flexion it forms a curve,

and not an angle; for, in the last case, the spinal marrow would be more or less compressed.

The cervical vertebræ have most motion, and the dorsal the least. This circumstance is fully explained by the form of the different parts of these vertebræ, and the difference in the thickness of the intervertebral substance. The necessity of fixing the dorsal vertebræ is very evident: as their motion would greatly interfere with the motion of the ribs in respiration.

The lumbar vertebræ have more motion than is commonly supposed; for, in addition to a certain degree of flexion, they perform a species of rotation or twisting, which is very observable in persons who are diseased in one of their hip joints; such persons move their whole pelvis, by a rotation of the lumbar vertebræ, to avoid moving the diseased joint.

False Vertebræ.

The lower pyramid, or under part of the spine, consists of one large triangular bone called *the os sacrum*, and of some small bones denominated the *os coccygis*.

These bones are called the false vertebræ, because the *sacrum* in young subjects is composed of five distinct bones, each of which has some resemblance to a vertebra; but they are completely united in the adult, and form but one bone, which is supposed to have been denominated sacrum, because it was offered in sacrifice by the ancients.

The *os sacrum* is of a triangular form, with its base upwards. It is concave anteriorly, and convex posteriorly. The middle of the bone, when viewed anteriorly, appears to be composed of the bodies of five vertebræ, united to each other, and their union is marked by four transverse lines. At the two extremities of each of these lines, are large round

holes, which communicate with the vertebral cavity of the bone.

On the exterior sides of these holes the surface is free from any marks of the original separation.

The middle of the upper surface, or base of the bone, is formed for articulating with the last lumbar vertebra, and has two oblique processes, with a groove on each side, which forms part of the foramen for transmitting the twenty-fourth pair of nerves.

The back part of the os sacrum is rough and convex: in the middle there are commonly three processes similar to the spinous processes of the lumbar vertebræ, and a fourth which is much smaller. Below this, there is a deficiency of the bony spine, and, the vertebral cavity is consequently open behind; but the sides of the canal continue lower down.

On each side of the spinous processes are four smaller holes, which are opposite to the larger holes on the anterior surface. Between the spinous processes and the anterior part, which resembles the bodies of vertebræ, is the continuation of the vertebral cavity which contains the spinal marrow. From the cauda equina, contained in this cavity, the great nerves of the lower extremities pass off, through the large holes on the anterior surface, and some small nerves through the posterior holes.

In some bones the spinous processes are entirely deficient, and the cavity above mentioned is completely open behind; but the contained parts are defended by strong membranes.

The anterior part of each lateral surface is covered by a plate of cartilage, and articulated to the os ilium. The posterior part is rough and perforated by the fibres of the strong ligaments, which are inserted into it.

On the posterior surface of the sacrum, the sides of the open part of the vertebral canal terminate, so

as to form a notch, through which passes the twenty-ninth pair of nerves.

The os sacrum is very spongy, and is lighter in proportion to its bulk than any bone in the body: it is defended by the muscles that cover it, and the ligaments which adhere to it.

It is articulated, above, to the last lumbar vertebra; below, to the os coccygis; and on the sides, to the ossa ilia.

That triangular chain of bones depending from the os sacrum, in which each bone becomes smaller as it descends, till the last ends in a small tubercle, is called *os coccygis.* It is convex behind, and concave before; from which crooked pyramidal figure, which was thought to resemble a cuckoo's beak, the name is derived.

There are four pieces in people of middle age. In children, they are almost wholly cartilaginous. In old subjects, all the bones are united, and become frequently one continued bone with the os sacrum.

The highest of the four bones is the largest, with shoulders extended farther to each side than the end of the os sacrum; which enlargement may serve as a distinguishing mark to fix the limits of either bone. The upper surface of this bone is a little hollow. From the back of that bulbous part called its *shoulders*, a process often rises up on each side, to join with the os sacrum. Sometimes these shoulders are joined to the sides of the open end of the vertebral canal, to form the hole in each side common to these two bones, for the passage of the twenty-ninth pair of spinal nerves. Immediately below the shoulders of the os coccygis, a notch may be remarked on each side, where the thirtieth pair of the spinal nerves passes. The lower end of this bone is formed into a small head, which very often is hollow in the middle.

The three lower bones gradually become smaller, and are spongy, but are strengthened by a strong ligament which covers and connects them. Their ends, by which they are articulated, are formed in the same manner as those of the first bone.

Between each of these four bones of young subjects a cartilage is interposed; therefore their articulation is analagous to that of the bodies of the vertebræ of the neck; for the lower end of the os sacrum, and of each of the three superior bones of the os coccygis, has a small depression in the middle; and the upper part of all the bones of the os coccygis is a little concave, and consequently the interposed cartilages are thickest in the middle, to fill up both cavities; by which they connect the bones more firmly. Then the cartilages ossify, the upper end of each bone is formed into a cavity, exactly adapted to the protuberant lower end of the bone immediately above. From this sort of articulation, it is evident, that, unless when these bones grow together, all of them are capable of motion; of which the first and second enjoy the largest share.

The lower end of the fourth bone terminates in a rough point, to which a cartilage is appended.

To the sides of these bones of the os coccygis, the coccygæi muscles, and part of the levatores ani, and of the glutæi maximi, are fixed.

The connexions of these bones hinder them from being moved to either side; and their motion backwards and forwards is much confined: yet as their ligaments can be stretched by a considerable force, it is of great advantage in the excretion of the fæces alvinæ, and much more in childbearing, that these bones should remain moveable; and the right management of them, in delivering women, is very important. The mobility of the os coccygis diminishing as people advance in age. especially when its

ligaments and cartilages have not been kept flexible by being stretched, is probably one reason why women, who are advanced in years before they marry, have generally difficult parturition.

These bones serve to sustain the intestinum rectum; and, therefore, are curved forwards; by which they are preserved, as well as the muscles and teguments, from any injury when sitting with the body reclined back.

The Vertebral Cavity for containing the Spinal Marrow.

The canal formed by the foramina of the different vertebræ, when these bones are placed in their natural order, extends from the great occipital foramen to the end of the sacrum. Its direction varies with the different curvatures of the spine, and its figure and diameter are also very different in different places.

In the cervical vertebræ, it is largest, and nearly triangular in form; in the dorsal, it is much smaller and almost cylindrical; in the lumbar, it is somewhat enlarged, and approaches again to the triangular figure; in the sacrum, it is broad, but flat, and diminishes gradually, so as to assume the form of a long triangle.

It has a ligamentous lining, which will be described when an account is given of the fresh bones and their ligaments.

The Thorax.

The thorax resembles a flattened cone, cut away obliquely at its basis; and regularly truncated at its apex.

It is formed by the dorsal vertebræ behind, the ribs on the sides, and the sternum before.

The Ribs

Are long crooked bones, placed in an oblique direction downwards as respects the back bone. Their

number is generally twelve on each side; though sometimes eleven or thirteen have been found.

They are convex externally and concave internally. They are made smooth by the action of the contained parts, which, on this account, are in no danger of being hurt by them.

The ribs approach towards a round form at their extremities near the vertebræ. Further forwards they are flat and broad, and have an upper and lower edge; each of which is made rough by the action of the intercostal muscles inserted into them. These muscles, being all of nearly equal force, and equally stretched in the interstices of the ribs, prevent the broken ends of these bones, in a fracture, from being removed far out of their natural place, to interrupt the motion of the vital organs. The upper edge of the ribs is more obtuse and rounder than the lower, which is deepened on its internal side by a long fossa, for lodging the intercostal vessels and nerves: on each side of which there is a ridge, to which the intercostal muscles are fixed. The fossa is not observable at the ends of the ribs; for, at the posterior, or root, the vessels have not yet reached the bones; and, at the fore end, they are split away, into branches, to serve the parts between the ribs.

From this situation of the blood vessels, has originated the rule adopted by surgeons, that the incision in cases of empyema, &c. should be made midway between the spine and sternum, and that the lower edge of the upper rib should be avoided.

At the posterior end of each rib, a little head is formed, which is divided by a middle ridge into two flat or hollow surfaces; the lowest of which is generally the broadest and deepest. The two surfaces are joined to the bodies of two different vertebræ, and the ridge forces itself into the intervening cartilage. A little way from this head, we find, on the

external surface, a small cavity, where mucilaginous glands are lodged; and round the head, the bone appears spongy, where the capsular ligament of the articulation is fixed. Immediately beyond this, a flatted tubercle rises, with a small cavity at its root, which is surrounded by a roughness, for the articulation of the rib with the transverse process of the lowest of the two vertebræ, with which the head of the rib is joined. Advancing further on this external surface, another smaller tubercle may be observed in most cases, into which, ligaments connecting the ribs to each other, and to the transverse processes of the vertebræ and portions of the longissimus dorsi, are inserted. Beyond this, these bones are made flat by the sacro-lumbalis muscle, which is inserted into the part of this flat surface furthest from the spine, where each rib makes a considerable curve, called by some its *angle.* Then the rib begins to turn broad, and continues so to its anterior end, which is hollow and spongy, for the reception of, and firm coalition with, the cartilage that runs thence to be inserted into the sternum, or to be joined with some other cartilage. In adults, the cavity at this end of the ribs is generally smooth.

The *substance* of the ribs is spongy, cellular, and only covered with a very thin external lamellated surface, which increases in thickness and strength as it approaches the vertebræ.

To the fore end of each rib a long broad and strong cartilage is fixed, which reaches the sternum, or is joined to the cartilage of the next rib. This course, however, is not in a straight line with the rib: for the cartilages generally make a considerable flexure, the concave part of which is upwards; therefore at their insertion into the sternum, they make an obtuse angle above, and an acute one below. These cartilages are of such a length as never to allow the

ribs to come to a right angle with the spine; but they keep them situated so obliquely as to make the angle very considerably obtuse above, till a force exceeding the elasticity of the cartilage is applied. These cartilages, as all others, are firmer and harder internally than they are on their external surface; and sometimes, in old people, all their middle substance becomes bony, while a thin cartilaginous lamella appears externally. The ossification, however, begins frequently at the external surface. The greatest alternate motions of the cartilages being made at their great curvature, that part remains frequently cartilaginous after all the rest is ossified.

The ribs then are *articulated* at each end, and that behind is doubly joined to the vertebræ; for the head is received into the cavities of two bodies of the vertebræ, and a larger tubercle is received into the depression in the transverse process of the lower vertebra. When we examine the double articulation, we must immediately see, that no other motion can here be allowed than upwards and downwards. Since the transverse process hinders the rib to be thrusted back, the resistance of the sternum on the other side prevents the ribs coming forward; and each of the two joints, with the other parts attached, oppose its turning round. But then it is likewise as evident, that even the motion upwards and downwards can be but small in any one rib at the articulation itself. But as the ribs advance forwards, the distance from their centre of motion increasing, the motion must be larger; and it would be very conspicuous at their anterior ends, were they not resisted there by the cartilages, which yield so little, that the principal motion is performed by the middle part of the ribs, which turns outwards and upwards, and occasions the twist remarkable in the long ribs at

the place near their fore end where they are more resisted.

The ribs differ from each other in the following respects:

The upper rib is the most crooked; and as they descend they become straighter. Their obliquity, with respect to the spine, increases as they descend; so that though their distances from each other are nearly equal at their back part, yet at their fore ends the distances between the lower ribs must increase. In consequence of this increased obliquity of the lower ribs, each of their cartilages makes a greater curve in its progress from the rib towards the sternum; and the tubercles, that are articulated to the transverse processes of the vertebræ, have their smooth surfaces gradually facing more upwards. The ribs becoming thus more oblique, while the sternum advances forwards in its descent, makes the distance between the sternum and the anterior end of the lower ribs greater than between the sternum and the ribs above; consequently, the cartilages of those ribs that are joined to the breast bone are longer in the lower than in the higher ones. These cartilages are placed nearer to each other as the ribs descend, which occasions their curvature to be greater.

The length of their ribs increases from the first and uppermost rib, as far down as the seventh; and from that to the twelfth, it gradually diminishes. The superior of the two surfaces, by which the ribs are articulated to the bodies of the vertebræ, gradually increases from the first to the fourth rib, and is diminished after that in each lower rib. The distance of their angles from the heads always increases as they descend to the ninth, because of the greater breadth of the sacro-lumbalis muscle.

The ribs are commonly divided into *true* and *false*. The *true* ribs are the seven uppermost of each side.

Their cartilages are all gradually longer as they descend, and are joined to the breast bone: so that, being pressed constantly between two bones, they are flattened at both ends; and are thicker, harder, and more liable to ossify, than the other cartilages, that are not subject to so much pressure. These bones include the heart and lungs; and therefore are called true ribs.

The five inferior ribs of each side are the *false*, whose cartilages do not reach to the sternum; but on this account having less pressure, their substance is softer. To these five ribs the circular edge of the diaphragm is connected.

The first rib of each side is so situated, that the flat sides are above and below, while one edge is placed inwards, and the other outwards, or nearly so: therefore sufficient space is left above it for the subclavian vessels and muscles; and the broad concave surface is opposed to the lungs. But in consequence of this situation, the channel for the intercostal vessels is not to be found. The head of this rib is not divided into two plane surfaces by a middle ridge, because it is only articulated with the first vertebra of the thorax. Its cartilage is frequently ossified in adults, and is united to the sternum at right angles. This first rib frequently has a ridge rising near the middle of its posterior edge, where one of the heads of the scalenii muscles rises. Farther forward it is flattened, or sometimes depressed by the clavicle.

The position of the second rib is such that its two broad surfaces have oblique aspects, inward and downward, outwards and upwards, so as to make the surface of the thorax uniform: and it may be observed of all the ribs, that the aspect of their surfaces is varied upon this principle. according to their situation in the thorax.

The sixth, seventh, and eighth ribs, have their cartilages nearly contiguous. They are frequently joined to each other by cross cartilages; and frequently the cartilages of the eighth, ninth, and tenth, are connected to the former, and to each other by firm ligaments.

The eleventh, and sometimes the tenth rib, has no tubercle for its articulation with the transverse process of the vertebra, to which it is only loosely fixed by ligaments. The fossa in its lower edge is not so deep as in the upper ribs; because the vessels run more towards the interstice between the ribs. Its front end is smaller than its body; and its short small cartilage is but loosely connected to the cartilage of the rib above.

The twelfth rib is the shortest and straightest. Its head is only articulated with the last vertebra of the thorax; and therefore is not divided into two surfaces. This rib is not joined to the transverse process of the vertebra, and therefore has no tubercle, being often pulled necessarily inwards by the diaphragm, which an articulation with the transverse process would not have allowed. The fossa is not found at its under edge, because the vessels run below it. The forepart of this rib is smaller than its middle, and has only a very small pointed cartilage fixed to it. To its whole internal side the diaphragm is connected.

The Sternum

Is the broad flat bone, in the front part of the thorax. In adults it is composed of three pieces, which easily separate after the cartilages connecting them are destroyed. The two lower pieces are frequently found intimately united; and very often, in old people, the sternum is a continued bony substance from one end to the other; though we still observe two,

sometimes three, transverse lines on its surface; which are marks of the former divisions.

The sternum, considered as one bone, is broadest and thickest above, and smaller as it descends. The internal surface of this bone is somewhat concave for enlarging the thorax: but the convexity on the external surface is not so conspicuous, because the sides are pressed outwards by the true ribs; the round heads of whose cartilages are received into seven smooth pits formed in each side of the sternum, and are kept firm there by strong ligaments, which on the external surface have a particular radiated texture. The pits at the upper part of the sternum are at the greatest distance one from another, and as they descend, are nearer; so that the two lowest are contiguous.

The *substance* of the breast bone is cellular, with a very thin external plate, especially on its internal surface, where we may frequently observe a cartilaginous crust spread over it. On both surfaces, however, a strong ligamentous membrane is closely braced; and the cells of this bone are so small, that a considerable quantity of osseous fibres must be employed in the composition of it. Whence, with the defence which the muscles give it, and the moveable support it has from the cartilages, it is sufficiently secured from being broken: for it is strong by its quantity of bone; its parts are kept together by ligaments; and it yields enough to elude considerably any violence offered.

The three pieces which compose this bone are very different from each other.

The first piece resembles a triangle with the corners cut off. The upper edge of it is thick, and has a regular depression in the middle, to accommodate the trachea. On each side of this depression is a superficial cavity, which on viewing it transversely

from before backwards, appears a little convex. Into these cavities the ends of the clavicles are received. Immediately below them the sides of this bone become thinner; and in each a superficial cavity, or a rough surface, is to be seen, where the first ribs are received or joined to the sternum. In the side of the under end of this first bone, the half of the pit for the second rib on each side is formed. The upper part of the surface behind is covered with a strong ligament, which secures the clavicles; and is afterwards to be more particularly taken notice of.

The *second*, or middle division of this bone, is much longer, narrower, and thinner, than the first; but excepting that it is a little narrower above than below, it is nearly uniform in its dimensions of breadth or thickness. In the sides of it are complete pits for the third, fourth, fifth, and sixth ribs, and one half of the pits for the second and seventh; the lines, which are marks of the former division of this bone, being extended from the middle of the pits of one side to the middle of the corresponding pits of the other side. Near its middle an unossified part of the bone has sometimes been found; which, freed of the ligamentous membrane or cartilage that fills it, is described as a hole. When the cartilage between this and the first bone is not ossified, a manifest motion of this upon the first may be observed in respiration; or in raising the sternum, by pulling the ribs upwards; or distending the lungs with air, in a recent subject.

The *third* bone is much less than the other two, and has only one half of the pit for the seventh rib formed in it; wherefore it might be reckoned only an appendix of the sternum. In young subjects it is always cartilaginous, and is better known by the name of *cartilago xiphoides* or *ensiformis*, than any other. This third bone is seldom of the same figure,

magnitude, or situation, in any two subjects; for sometimes it is triangular; with one of the angles below, and perpendicular to the middle of the upper side, by which it is connected to the second bone. In other persons, the point is turned to one side; or obliquely forwards or backwards. Frequently it is nearly of an equal breadth, and often, it is bifurcated; sometimes also, it is unossified in the middle. In the greatest number of adults, it is ossified, and tipped with a cartilage; in some, one half of it is cartilaginous; and in others, it is all in a cartilaginous state.

The sternum is *joined* by cartilages to the seven upper ribs, except when the first coalesce with it. It is also articulated with the clavicles.

It contributes to the formation of the cavity of the thorax, and supports the mediastinum. As a moveable fulcrum for the ribs, it assists in respiration; and it affords origin and insertion to several muscles.

The Movement of the Ribs and Sternum in Respiration.

The ribs and their cartilages are articulated to the spine behind, and the sternum before, in a way which admits of a compound motion.

They are drawn from a position which slopes obliquely downwards and forwards, into one which is more horizontal; and the posterior extremity of each rib, which is the centre of this motion, is moved very little, while the anterior extremity moves much more.

At the same time, the ribs perform a rotation outwards, upon their extremities connected with the spine and sternum; in consequence of which, the middle of each rib is moved outwards to a considerable extent.

It is very obvious, that by these motions, the tho-

rax must be enlarged from side to side, and from behind forwards.

As the ribs are raised from the oblique toward the horizontal position, the sternum is necessarily moved forward by them; and if this bone does not move upon the first rib, the rib must move to accommodate it: a small motion at the articulation of the rib with the spine, being sufficient to produce considerable motion at the lower end of the sternum. The sternum, therefore, vibrates forward when the ribs are elevated, and backward when they are depressed.

In easy respiration these motions are not very great, for then the enlargement of the thorax appears to be produced by the increase of its verticle diameter, in consequence of the descent of the diaphragm; but when the inspirations are very large, and when the descent of the diaphragm is impeded, as in pregnancy, and in ascites, these motions are very considerable.

It ought to be observed, that the first rib has very little motion, except the rotation which favours the motion of the sternum; and that the lower ribs, having no support at their anterior extremities, have no rotation.

The Pelvis.

The pelvis is the cavity at the lower part of the trunk, formed by the os sacrum, os coccygis, and ossa innominata.

The ossa innominata are the two large bones which are connected to the sacrum behind, and to each other, by the intervention of a cartilage, in front.

Each of the ossa innominata is composed of three portions, in children; and although these are united in adults, so as to form but one bone, yet anatomists have generally considered the bone as divided into its original parts, which are denominated os ilium. os ischium, and os pubis.

The original separation is at the acetabulum, or cavity for receiving the head of the os femoris, which is on the outside of the os innominatum. The upper and posterior part of this cavity, to the amount of two-fifths, is formed by the os ilium, two-fifths of the inferior portion by the os ischium, and the anterior fifth by the os pubis.

The os ilium is the largest of the three portions. Its external surface has been called its dorsum, and the internal concave surface its costa. The semicircular edge at the upper part of the bone, is named the spine: the external oblique muscle of the abdomen is inserted into it, and the internal oblique, and the transversalis arise from it. The ends of the spine are prominent, and therefore are called processes. At a small distance below the anterior spinous process, is another protuberance, called the inferior anterior spinous process; and the edge of the bone between these two processes is curved.

Below the posterior spinal process, another protuberance is also observable, which is applied closely to the os sacrum. Under this is a large notch, which, with the ligaments that pass from the os sacrum to the os ischium, forms a foramen, through which the great sciatic nerve, the pyriform muscle, and some blood vessels pass.

The external surface, or dorsum, of the os ilium, is greatly undulated by the action of muscles that lie upon it: the gluteus maximus, on the posterior, and the gluteus medius and minimus, on the anterior parts of it. The lower part of this bone, which contributes to the formation of the acetabulum, is the thickest.

The internal surface of the os ilium is concave, and supports some of the intestines. From this concave surface a slight concavity is continued obliquely forwards, at the inside of the anterior inferior spinal process, where part of the psoas and iliacus muscles,

with the crural vessels and nerves, pass. The large concavity is bounded below by a sharp ridge, which runs from behind forwards; and, being continued with such another ridge of the os pubis, forms a line of partition between the cavities of the abdomen and pelvis. Into this ridge the broad tendon of the psoas parvus is inserted.

All the internal surface of the os ilium, behind the continuance of this ridge, is very unequal: for the upper part is flat, but spongy, where the sacro-lumbalis and longissimus dorsi rise. Lower down, there is a transverse ridge, from which ligaments go out to the os sacrum. Immediately below this ridge, the rough unequal cavities and prominences are placed, which are exactly adapted to those described on the side of the os sacrum. In the same manner, the upper part of this rough surface is porous, for the firmer adhesion of the ligamentous cellular substance; while the lower part is more solid, and covered with a thin cartilaginous skin, for its immoveable articulation with the os sacrum. From all the circumference of this large unequal surface, ligaments are extended to the os sacrum, to secure more firmly the conjunction of these bones.

The passages of the medullary vessels are very conspicuous, both in the dorsum and costa of many ossa ilia; but in others they are inconsiderable.

The posterior and lower parts of these bones are thick; but they are generally exceedingly thin and compact at their middle, where they are exposed to the actions of the musculi glutæi and iliacus internus, and to the pressure of the bowels contained in the belly. The substance of the ossa ilia is cellular, except a thin external plate.

Os Ischium, or hip bone, is of a middle size between the two other parts of the os innominatum, and of a very irregular figure. Its extent might be

marked by a horizontal line drawn a little below the middle of the acetabulum; for the upper bulbous part of this bone forms rather less than the lower half of that great cavity, and the small leg of it rises to much the same height, on the other side of the great hole, common to this bone and the os pubis.

From the upper thick part of the os ischium, a sharp process, called by some authors *spinous*, stands out backwards, from which chiefly the musculus coccygæus and superior gemellus, and part of the levator ani, rise; and the anterior, or internal, sacro-sciatic ligament is fixed to it. Between the upper part of this ligament and the bones, it was formerly observed that the pyriform muscle, the posterior crural vessels, and the sciatic nerve pass out of the pelvis. Immediately below this process, is a depression for the tendon of the obturator internus muscle. In a recent subject, this part of the bone, which serves as a pully on which the obturator muscle plays with a ligamentous cartilage.

Below the depression of the obturator muscle, is the great knob or tuberosity, covered with cartilage or tendon. The upper part of the tuberosity gives rise to the inferior gemellus muscle. To a ridge at the inside of this, the external, or posterior, sacro-sciatic ligament is so fixed, that between it, the internal ligament, and the sinuosity of the os ischium, a passage is left for the internal obturator muscle. The upper thick smooth part of the *tuber*, called by some its *dorsum*, has two oblique impressions on it. The inner one gives origin to the long head of the biceps flexor tibiæ, and semitendinosus muscles; and the semimembranosus rises from the exterior one, which reaches higher and nearer the acetabulum than the other. The lower, thinner, more scabrous part of the knob, which bends forwards, is also marked with two flat surfaces; whereof the internal is what

we lean upon in sitting, and the external gives rise to the largest head of the triceps adductor femoris. Between the external margin of the tuberosity, and the great hole of the os innominatum, there is frequently an obtuse ridge extended down from the acetabulum, which gives origin to the quadratus femoris. As the tuber advances forwards, it becomes smaller, and is rough, for the origin of the musculus transversalis and erector penis. The small leg of it, which mounts upwards to join the os pubis, is rough and prominent at its edge, where the two lower heads of the triceps adductor femoris take their rise.

The upper and back part of the os ischium is broad and thick; but its lower and forepart is narrower and thinner. Its substance is of the structure common to broad bones.

The os ilium and pubis, of the same sides, are the only bones which are contiguous to the os ischium.

The OS PUBIS, the least of the three portions of the os innominatum, is placed at the upper and front part of it. The thick largest part of this bone is employed in forming the acetabulum; from which, becoming much smaller, it is stretched inwards to its fellow of the other side, where it again grows larger, and forms a surface to be connected with the cartilage of its symphysis, and then sends a small branch downwards to join the end of the small leg of the os ischium. The upper surface of each os pubis is broad, near its junction with the cartilage of the symphysis; on the internal edge of this surface begins a ridge which is continued from it along the os ilium, and forms the division between the cavities of the abdomen and pelvis. This ridge is called crista, and including that on the ilium, linea innominata, or ileo-pectinea. On the anterior and external edge of this surface of the pubis, at a small distance from the cartilage, is a prominence or process, called the spine.

From this process another ridge, which is much more obtuse, extends to the acetabulum. The upper surface of the pubis, which is included betwen these ridges, is concave, for the transmission of the crural vessels, and nerve, and the psoas and iliacus internus muscles.

Immediately below the lower ridge, and near the acetabulum, a winding notch is made, which is comprehended in the great contiguous foramen; but is formed into a hole in the recent subject, by a subtended ligament, for the passage of the posterior crural nerve, and artery, and a vein. The internal end of the os pubis is rough and unequal, for the firmer adhesion of the thick ligamentous cartilage that connects it to its fellow of the other side. The process which goes down from that to the os ischium is broad and rough before, where the gracilis and upper heads of the triceps adductor femoris have their origin.

The substance of the os pubis is the same as that of other broad bones.

Between the os ischium and pubis a very large irregular hole is left, which has been called *thyroideum.* The whole of this foramen, except the notch for the posterior crural nerve, is filled up, in a recent subject, with a strong ligamentous membrane, that adheres very firmly to its circumference. From this membrane chiefly, the two external and internal obturator muscles take their rise. The great design of this hole, besides rendering the bone lighter, is to allow a strong origin to the obturator muscles, and sufficient space for lodging them; that there may be no danger of disturbing the functions of the contained viscera of the pelvis by the actions of the internal; nor of the external being bruised by the thigh bone, especially by its lesser trochanter, in the motions of the thigh inwards: both which inconveniences must have happened, had the ossa innominata been com-

plete here, and of sufficient thickness and strength, to serve as the fixed point of these muscles.

The bowels sometimes make their way through the notch for the vessels, at the upper part of this thyroid hole; and this causes a hernia in this place.

The acetabulum is situated near the outside of the great foramen. The margin of this cavity is very high, and is still much more enlarged by the ligamentous cartilage, with which it is tipped in a recent subject; round the base of this margin the bone is rough and unequal, where the capsular ligament of the articulation is fixed. At the upper and back part of the acetabulum the margin is much larger and higher than any where else; which is very necessary to prevent the head of the femur from slipping out of its cavity at this place, where the whole weight of the body bears upon it, and consequently might otherwise thrust it out. As the margin is extended downwards and forwards, it becomes less; and at the internal lower part is a deficiency in it; from the one side of which to the other, a ligament is placed in the recent subject; under which a large hole is left. Besides this difference in the height of the margin, the acetabulum is otherwise unequal; for the lower internal part of it is depressed below the cartilaginous surface of the upper part, and is not covered with cartilage; into the upper part of this particular depression, where it is deepest and of a semilunar form, the ligament of the thigh bone, commonly, though improperly, called the *round one*, is inserted: while, in its more superficial lower part, a large glandlike body is lodged. The greatest part of this separate depression is formed in the os ischium.

The *ossa innominata* are *joined*, at their back part, to each side of the os sacrum, by a sort of suture, with a very thin intervening cartilage which serves

to cement these bones together; and strong ligaments go from the circumference of this unequal surface, to connect them more firmly. They are connected together at their forepart by the ligamentous cartilage interposed between the two ossa pubis, and therefore have no motion in a natural state, except what is common to the trunk of the body, or to the os sacrum.

Considering the great weight that is supported in our erect posture, by the articulation of the ossa innominata with the os sacrum, there is great reason to think, that if the conglutinated surfaces of these bones were once separated, (without which the ossa pubis cannot move on each other,) the ligaments would be violently stretched, if not torn.

Each os innominatum affords a socket (the acetabulum) for the thigh bones to move in; and the trunk of the body rolls so much on the heads of the thigh bones, as to allow here the most conspicuous motions of the trunk, which are commonly thought to be performed by the bones of the spine.

The form of the cavity of the pelvis, at its upper opening, or brim, is somewhat oval; as a line drawn from one side to the other, is about an inch longer than a line drawn from the back to the front part of it.

This margin is well defined by the ridge on the surface of the ossa ilia, and the upper edge of the os pubis; but the margin of the lower opening is very irregular; and it ought be observed that the dimensions of this opening are made less by the sacro sciatic ligaments, than they appear upon an examination of the bare bones.

In consequence of the oblique position of the sacrum, sloping downwards and backwards, the position of the pelvis is very oblique. A line drawn through the centre of this cavity, perpendicular to the plane of the upper orifice, or brim, would not co-

incide with the vertical diameter of the cavity of the abdomen, but would pass out of that cavity near the umbilicus.

This cavity, and the bones which form it, are different in the two sexes.

In women the brim of the pelvis is wider, and inclines more to the oval form.

In men this opening is more circular.

The outlet or lower opening of the pelvis is also larger in women.

This greater size of the pelvis and its openings, in women, is derived particularly from the following circumstances.

The os sacrum is broader, and sometimes straighter than in men.

The ossa ilia are flatter, and consequently the ossa ischia are farther apart.

The ligamentous cartilage at the symphysis pubis is broader, and shorter.

The angle formed by the crura of the ossa pubis with each other, at the symphysis, is much larger.

The Trunk of the Fœtus.

At birth, each *vertebra* consists of three pieces, connected by cartilages, viz. The *body* not perfectly ossified; and a *bone on each side of it*, of a form almost rectangular, on which the *oblique processes* are very distinguishable, and the *transverse processes* may be ascertained. These bones are so applied to the body, as to include a triangular space for the vertebral cavity. The ends of the longest portions are nearly in contact behind; but the *spinous process* is not formed. The *atlas* is cartilaginous in front, and has only the two lateral portions ossified. The *vertebra dentata* consists of four pieces; for in addition to the three pieces, common to the other vertebræ, the *processus dentatus* is a distinct portion.

The *false vertebræ*, of which the *sacrum* consists, are each formed of three bones as the true vertebræ.

The bones of the *os coccygis* are cartilaginous, except the first, which is partly ossified.

The *ribs* are almost perfect at birth: their heads and tubercles covered with cartilage. The necessity of their motion in respiration, immediately after birth, explains this difference between them, and most of the other bones of the fœtus.

The *sternum* consists of several small bones, surrounded by flat cartilages. Ossification goes on in these cartilages from various points; and the distinct bones finally unite into the three pieces of which the sternum is finally composed.

The *ossa innominata* on each side are formed of three distinct pieces, united at the acetabulum.

The *spine* of the *os ilium* is cartilaginous; and the lower part of the bone is not completely ossified.

The back part of the *os ischium* is ossified; but the portion which forms the acetabulum, the tuber, and the crus is cartilaginous.

The upper part of the *os pubis*, and that portion which forms the symphysis, are ossified. The crus-like that of the ischium, is cartilaginous.

SECTION III.

Of the Superior Extremities.

Each superior extremity consists of the Shoulder, the Arm, the Fore Arm, and the Hand.

The *shoulder* is composed of the *clavicle* and *scapula*. It has been supposed by some persons that the two last mentioned bones belong properly to the thorax; but upon examining the motions of the upper extremity it will appear, that they form an essential part of it: and it is equally evident that they do not

contribute to the perfection of the thorax; they are therefore considered as a part of the upper extremity.

The *clavicle* is the long crooked bone resembling the italic *f*, which is placed almost horizontally between the upper lateral part of the sternum and the acromion, or most prominent process of the scapula, which it keeps off from the trunk of the body.

The clavicle, as well as other long bones, is larger at its two ends than in the middle. The end next to the sternum is triangular; the angle behind is considerably protruded, to form a sharp ridge, to which the transverse ligament, extended from one clavicle to the other, is fixed. The side opposite to this is somewhat rounded. The middle of this protuberant end is irregularly hollowed, as well as the cavity in the sternum for receiving it: but, in a recent subject, the irregular concavities of both are supplied by a moveable cartilage; which is not only much more closely connected every where, by ligaments, to the circumference of the articulation, than those of the lower jaw are, but it grows to the two bones at both its internal and external end: its substance at the external end being soft, but very strong, and resembling the intervertebral cartilages.

From its internal end, the clavicle, for about two-fifths of its length, is bended obliquely forwards. On the upper and front part of this curvature a small ridge is seen, with a plane rough surface before it; whence the sterno-hyoideus and sterno-mastoideus muscles have in part their origin. Near the lower angle, a small plane surface is often to be remarked, where the first rib and this bone are contiguous, and are connected by a firm ligament. From this a rough plane surface is extended outwards, where the pectoral muscle has part of its origin. Behind, the bone is made flat and rough by the insertion of the larger

share of the subclavian muscle. The clavicle is then curved backwards, and at first is round; but it soon after becomes broad and thin; which shape it retains to its external end. Along the external concavity a rough sinuosity runs; from which some part of the deltoid muscle takes its rise: opposite to this, on the convex edge, a scabrous ridge gives insertion to a share of the cucullaris muscle. The upper surface of the clavicle is here flat; but the lower is hollow, for lodging the beginning of the musculus subclavius; and towards its back part, a tubercle rises; to which and to a roughness near it, the strong short thick ligament, connecting this bone to the coracoid process of the scapula, is fixed.

The external end of this bone is oblong horizontally, smooth, sloping at the posterior side, and tipped in a recent subject with a cartilage, for its articulation with the acromion scapulæ. Round this the bone is spongy, for the firmer connexion of the ligaments.

The surfaces of contact of this bone, and the scapula, are remarkably small, and flat also.

The medullary arteries, having their direction obliquely outwards, enter the clavicles by one or more small passages in the middle of their back part.

The *substance* of this bone is the same as of the other round long bones.

The ligaments which surround the articulation of this bone with the sternum, are so short and strong, that little motion can be allowed any way; and the strong ligament that is stretched across the upper furcula of the sternum, from the posterior prominent angle of the one clavicle to the same place of the other clavicle, serves to keep each of these bones more firmly in its place. By the assistance, however, of the moveable intervening cartilage, the clavicle can move at this articulation so that the external ex-

tremity may be elevated or depressed, and moved backwards and forwards. The whole bone may be moved so as to describe a cone; of which the end at the sternum is the apex.

The movements of the scapula and arm are the objects of these motions of the clavicle; and the general use of the bone is to regulate the motions of these parts.

From the situation, figure, and use of the clavicles, it is evident that they are much exposed to fractures: that their broken parts must generally pass each other; and, that they will be kept in their places with difficulty.

The Scapula.

Or *shoulder-blade*, is the triangular bone situated on the upper and back part of the thorax. The back part of the scapula has nothing but the thin ends of the serratus anticus major, and subscapularis muscles between it and the ribs: but as this bone advances forwards, its distance from the ribs increases. The longest side of this bone is nearest the spine, and has an oblique position as respects it. The upper or shortest side, called the *superior costa* of the scapula, is nearly horizontal, and parallel with the second rib. The lower side, which is named the *inferior costa*, is extended obliquely from the third to the eighth rib. The situation of this bone, here described, is when people are sitting or standing in a state of inactivity, and allowing the members to remain in the most natural easy posture. The inferior angle of the scapula is very acute; the upper one is near to a right angle; and what is called the anterior does not deserve the name, for the two sides do not meet to form an angle. The body of this bone is concave towards the ribs, and convex behind, where it has the name of *dorsum*.

Three processes are generally reckoned to proceed from the scapula. The first is the large spine that rises from its convex surface behind, and divides it unequally. The second process stands out from the forepart of the upper side; and, from its imaginary resemblance to a crow's beak, is named *coracoides*. The third process is the whole thick bulbous forepart of the bone.

Into the oblique space the musculus patientiæ is inserted. At the root of the spine, on the back part of the base, a triangular flat surface is formed by the pressure of the lower fibres of the trapezius. Below this, the edge of the scapula is scabrous and rough, for the insertion of the serratus major anticus and rhomboid muscles.

The back part of the inferior angle is made smooth by the latissimus dorsi passing over it. This muscle also alters the direction of the inferior costa some way forwards from this angle: and so far it is flattened behind by the origin of the teres major. As the inferior costa advances forward, it is of considerable thickness, is slightly hollowed, and made smooth behind, by the teres minor; while it has a fossa formed into it below, by part of the subscapularis; and between the two, a ridge with a small depression appears, where the longus extensor cubiti has its origin.

The superior costa is very thin: and near its forepart there is a semilunar notch, from one end of which to the other, a ligament is stretched; and sometimes the bone is continued to form one, or sometimes two holes, for the passage of the scapula blood vessels and nerves. Immediately behind this semilunar cavity, the coraco-hyoideus muscle has its rise. From the notch, to the termination of the fossa for the teres minor, the scapula is narrower than any where else, and supports the third process. This part has the name of *cervix*.

The whole dorsum of the scapula is always said to be convex; but, by reason of the raised edges that surround it, it is divided into two cavities by the spine, which is stretched from behind forwards, much nearer to the superior than to the inferior costa. The cavity above the spine is really concave, where the supra-spinatus muscle is lodged; while the surface of this bone below the spine, on which the infra-spinatus muscle is placed, is convex, except a fossa that runs at the side of the inferior costa.

The internal or anterior surface of this bone is hollow, except in the part above the spine, which is convex. The subscapularis muscle is extended over this surface, where it forms several ridges and intermediate depressions, commonly mistaken for prints of the ribs: they point out the interstices of the bundles of fibres of which the subscapularis muscle is composed.

The spine rises small at the base of the scapula, and becomes higher and broader as it advances forwards. On the sides it is unequally hollowed and crooked, by the action of the adjacent muscles. Its ridge is divided into two rough flat surfaces: into the upper one the trapezius muscle is inserted; and the lower one has part of the deltoid fixed to it. The end of the spine, called *acromion*, or top of the shoulder, is broad and flat, and is sometimes only joined to the spine by a cartilage. The anterior edge of the acromion is flat, smooth, and covered with a cartilage, for its articulation with the external end of the clavicle; and it is hollowed below, to allow a passage to the infra and supra spinati muscles, and free motion to the os humeri.

The coracoid process is crooked, with its point inclining forwards; so that a hollow is left at the lower side of its root, for the passage of the subscapularis muscle. The end of this process is marked with

three plane surfaces. Into the internal, the pectoralis minor is inserted; from the external, one head of the biceps flexor cubiti rises; and from the lower one, the coraco brachialis has its origin. At the upper part of the root of this process, immediately before the semilunar cavity, a smooth tubercle appears, where a ligament from the cavicle is fixed. From the whole of the external side of this coracoid apophysis a broad ligament goes out, which becomes narrower where it is fixed to the acromion.

From the cervix scapulæ the third process is produced. The forepart of this is formed into a glenoid cavity, which is of the shape of the longitudinal section of an egg, being broad below and narrow above. Between the margin of this cavity and the forepart of the root of the spine, a large sinuosity is left for the transmission of the supra and infra spinati muscles; and on the upper part of this margin we may remark a smooth surface, where the second head of the biceps flexor cubiti has its origin. The root of the margin is rough all around, for the firmer adhesion of the capsular ligament of the articulation, and of the cartilage; which is thick on the margin, but becomes very thin as it is continued towards the middle of the cavity, which it lines all over.

The medullary vessels enter the scapula near the base of the spine.

The *substance* of the scapula, as in all other broad flat bones, is cellular, but of an unequal thickness: for the neck and third process are thick and strong; the inferior costa, spine, and, coracoid process, are of a middle thickness; and the body is so pressed by the muscles, as to become thin and transparent.

The scapula and clavicle are *joined* by plane surfaces, tipped with cartilage; by which neither bone is allowed any considerable motion, being tightly tied down by the common capsular ligament, and by

a very strong one which proceeds from the coracoid process; but divides into two before it is fixed into the clavicle, with such a direction, as can either allow this bone to have a small rotation, in which its posterior edge turns more backwards, while the anterior one rises farther forwards; or it can yield to the forepart of the scapula moving downwards, while the back part of it is drawn upwards; in both which cases, the oblong smooth articulated surfaces of the clavicle and scapula are not in the same plane, but stand a little transversely, or across each other, and thereby preserve this joint from luxations, to which it would be subject if either of the bones was to move on the other perpendicularly up and down, without any rotation. Sometimes a moveable ligamentous cartilage is found in this joint; and sometimes such a cartilage is only interposed at the anterior half of it; and in some old subjects a sesamoid bone has been found here.

The scapula is connected to the head, os hyoides, vertebræ, ribs, and arm bone, by muscles, that have one end fastened to these parts, and the other to the scapula, which can move it upwards, downwards, backwards, or forwards; by the quick succession of these motions, its whole body is caried in a circle. But being also often moved as upon an axis perpendicular to its plane, its circumference turns in a circle whose centre this axis is. Whichever of these motions it performs, it always carries the outer end of the clavicle and the arm along with it. The glenoid cavity of this bone receives the os humeri, which plays in it, as will be more fully explained hereafter.

The *use* of the scapula is, to serve as a fulcrum to the arm; and by altering its position on different occasions, to allow always to the head of the os humeri a socket to move in properly situated; and thereby, to assist and to enlarge greatly the motions

of the superior extremity, and to afford the muscles which rise from it more advantageous actions, by altering their directions with respect to the bone which they are to move. This bone also serves to defend the back part of the thorax, and is often employed to sustain weights, or to resist forces, too great for the arm to bear.

The Arm.

The *arm* has only one bone, best known by the Latin name of *os humeri;* which is long, round, and nearly straight.

The upper end of this bone consists of a large round smooth head, which forms the segment of a sphere, whose axis is not in a straight line with the axis of the bone, but stands obliquely backwards from it. The extent of the head is distinguished by a circular fossa surrounding its base, where the head is united to the bone, and the capsular ligament of the joint is fixed. Below the forepart of its base, two tubercles stand out: the smallest one, which is situated most to the inside, has the tendon of the subscapularis muscle inserted into it. The larger more external protuberance is divided, at its upper part, into three smooth plane surfaces: into the anterior of which, the musculus supra-spinatus; into the middle or largest, the infra-spinatus; and into the one behind, the teres minor, is inserted. Between these two tubercles, exactly in the forepart of the bone, a deep long groove is formed, for lodging the tendinous head of the biceps flexor cubiti; which, after passing, in a manner peculiar to itself, through the cavity of the articulation, is tied down, by a tendinous sheath extended across the groove; in which, and in the neighbouring tubercles, are several remarkable holes, which are penetrated by the tendinous and ligamentous fibres, and by vessels. On each

side of this groove, as it descends in the os humeri, a rough ridge, gently flattened in the middle, runs from the roots of the tubercles. The tendon of the pectoral muscle is fixed into the anterior of these ridges, and the latissimus dorsi and teres major are inserted into the internal one. A little behind the lower end of this last, another rough ridge may be observed, where the coraco-brachialis is inserted. From the back part of the root of the largest tubercle, a ridge also is continued; from which the extensor brevis cubiti arises. This bone is flattened on the inside, about its middle, by the belly of the biceps flexor cubiti. In the middle of this plane surface, the entry of the medullary artery is seen slanting obliquely downwards. At the foreside of this plane the bone rises in a sort of ridge, which is rough, and often has a great many small holes in it, where the strong deltoid muscle is inserted; on each side of which the bone is smooth and flat, where the brachiæus internus rises. The exterior of these two flat surfaces is the largest: behind it a superficial spiral channel, formed by the muscular nerve and the vessels that accompany it, runs from behind forwards and downwards.

The body of the os humeri is flattened behind by the extensors of the fore arm.

Near the lower end of this bone, a large sharp ridge is extended on its outside; from which the musculus supinator radii longus, and the longest head of the extensor carpi radialis, arise. Opposite to this, there is another small ridge to which the aponeurotic tendon, that gives origin to the fibres of the internal and external brachial muscles, is fixed; and from a little depression on the foreside of it, the pronator radii teres arises.

The body of the os humeri becomes gradually broader towards the lower end, where it has several processes; at the roots of which there is a cavity be-

fore, and another behind. The anterior is divided by a ridge into two; the external, which is the least, receives the end of the radius; and the internal receives the coronoid process of the ulna, in the flexions of the fore arm; while the posterior deep triangular cavity lodges the olecranon in the extensions of that limb. The bone between these two cavities is pressed so thin by the processes of the ulna, as to appear transparent in many subjects. The sides of the posterior cavity are stretched out into two processes, one on each side: These are called *condyles;* from each of which a strong ligament goes out to the bones of the fore arm. The external condyle, which has an oblique direction forwards with respect to the internal, when the arm is in the most natural posture, is equally broad, and has an obtuse smooth head rising from it forwards. From the rough part of the condyle, several muscles arise; and on the smooth head the upper end of the radius plays. The internal condyle is more pointed and protuberant than the external, to give origin to the flexor muscles of the wrist and hand, &c. Between the two condyles, is the trochlea or pulley; which consists of two lateral protuberances, and a middle cavity, that are smooth and covered with cartilage. When the fore arm is extended, the tendon of the internal brachiæus muscle is lodged in the forepart of the cavity of this pulley. The external protuberance, which is less than the other, has a sharp edge behind; but forwards, this ridge is obtuse, and only separated from the little head, already described, by a small fossa, in which the adjoining edges of the ulna and radius move. The internal protuberance of the pulley is largest and highest; and, therefore, in the motions of the ulna upon it, that bone would be inclined outwards, were it not supported by the radius on that side. Between this internal protuberance and con-

condyle, a sinuosity may be remarked, where the ulnar nerve passes.

The *substance* and the internal structure of the os humeri are the same, and disposed in the same way, as in other long bones.

The round head, at the upper end of this bone, is *articulated* with the glenoid cavity of the scapula; which being superficial, and having long ligaments, allows the arm a free and extensive motion. These ligaments are, however, considerably strong. For besides the common capsular ligament, the tendons of the muscles perform the office, and have been described under the name of *ligaments.* Then the acromion and coracoid process, with the strong broad ligaments stretched between them, secure the articulation above, where the greatest and most frequent force is applied to thrust the head of the bone out of its place. It is true, that there is not near so strong a defence in the lower part of the articulation; but, in the ordinary postures of the arm, that is, so long as it is an acute angle with the trunk of the body, there cannot be any force applied at this place to occasion a luxation, since the joint is protected so well above.

The motions which the arm enjoys by this articulation, are to every side; and by the succession of these different motions, a circle may be described. Besides which, the bone performs a small rotation round its own axis; but when the axis of the bone is the centre of motion, the movements are very different from those which take place when the axis of its head is the centre; for the axis of the head forms a very large angle with the axis of the body of the bone. Thus, when the arm swings backwards and forwards, the axis of the head is the centre of motion; but when the elbow is bent, and the fore arm forms a right angle with the os humeri, the motion

which applies the fore arm to the thorax, or removes it, is a rotation of this bone on its axis.

Though the motions of the arm seem to be very extensive, yet the larger share of them depends on the motions of the scapula; for the surface of the glenoid cavity is directed upwards or downwards, and to a certain degree backwards or forwards to support the head of the os humeri. This is exemplified when we press the hand against a body which is before, or above, or to one side of us.

The lower end of the os humeri is articulated to the bones of the fore arm, and carries them with it in all its motions; but serves as a base, on which they perform the motions peculiar to themselves; as will shortly be described.

The Fore Arm

Consists of two bones, one of which is called *ulna*, from its being used as a measure; and the other *radius*, from the supposed resemblance to the spoke of a wheel.

These bones are concerned in very different operations. The ulna forms the elbow joint with the os humeri: the radius is the moveable basis of the hand.

Ulna.

The length of this bone is equal to the fore arm, of which it is a part. It is thickest above, and gradually diminishes until near its lower end. The body of the bone is nearly triangular in form. At the upper extremity of the ulna, on its anterior surface, is a semicircular notch. The end of the bone which forms the posterior part of this notch is denominated *olecranon*. The anterior part of the notch is formed by a process called coronoid. This notch applies to the pulley-like surface on the internal side

of the lower extremity of the os humeri, to form the articulation of the elbow. In the middle of the concave surface is a ridge, in consequence of which a small rocking motion is performed by the ulna. The external surface of the olecranon is rough, and strongly marked. The extensor muscle of the fore arm is inserted into the end of it, and below this is a flat surface on which we lean. On the outside of the coronoid process is a semilunated smooth cavity, lined with cartilage; in which and in a ligament extended from the one to the other end of this cavity, the round head of the radius plays. Immediately below it, a rough hollow gives lodging to mucilaginous glands. Below the root of the coronoid process, this bone is scabrous and unequal, where the brachiæus internus is inserted. On the outside of that we observe a smooth concavity, where the beginning of the flexor digitorum profundus sprouts out.

The external angle of the triangular part of the ulna is very sharp, where the ligament that connects the two bones is fixed: the sides which make this angle are flat and rough, by the action and adhesion of the many muscles which are situated here. At the distance of one-third of the length of the ulna from the top, in its forepart, the passage of the medullary vessels may be seen slanting upwards. The internal side of this bone is smooth, somewhat convex, and the angles at each edge of it are blunted by the pressure of the muscles equally disposed about them.

As this bone descends, it becomes gradually smaller; so that its lower end terminates in a little head, standing on a small neck: towards the inner and back part of which last, an oblique ridge runs, that gives rise to the pronator radii quadratus. The head is somewhat cylindrical, smooth, and covered with a cartilage on its external side, to be received into the semilunar cavity of the radius; while a styloid pro-

cess rises from its inside, to which is fixed a strong ligament that is extended to the os cuneiforme and pisiforme of the wrist. At the root of the process, the end of the bone is smooth, and covered with a cartilage. Between it and the bones of the wrist, a doubly concave moveable cartilage is interposed; which is a continuation of the cartilage that covers the lower end of the radius, and is connected loosely to the root of the styloid process, and to the rough cavity there; in which mucilaginous glands are lodged.

The ulna is principally concerned in the articulation with the os humeri, and forms a hinge-like joint, which allows extension nearly to a straight line, and flexion to an acute angle. By the sloping of the pulley-like surface, the lower part of the arm is turned outwards in the extension, and inwards in the flexion; which greatly facilitates the motion of the hand towards the head.

Radius.

Before the radius is described, it is necessary to observe, that the lower end of this bone occasionally revolves half round the lower end of the ulna, and the hand with it. The relative situation of these parts is therefore different in different positions of the hand. In the following description, the palm of the hand is supposed to present forwards, and the thumb outwards; in which case, the two bones of the fore arm will be parallel to each other.

The *radius* is situated on the outside of the fore arm, and is rather shorter than the ulna. Its extremities are the reverse of those of the ulna in their proportionate size; and the body is not triangular, although it approaches towards that form. Its upper end is formed into a cylindrical head, which is hollowed on the top for an articulation with the tubercle at the side of the pulley of the os humeri; and the half cylindrical circumference next to the ulna is smooth, and covered with a cartilage, in order to be received into the seminulated cavity of that bone.

Below the head, the radius is much smaller; and therefore this part is named its *cervix*. At the internal root of this neck is a flat tubercle, into the inner part of which the biceps flexor cubiti is inserted. From this a ridge runs downwards and outwards, where the supinator radii brevis is inserted; and a little below, and behind this ridge, there is a rough scabrous surface, where the pronator radii teres is fixed.

The body of the radius is not straight, but curved externally, the greater part of its length. Its external surface is rounded; the anterior and posterior surfaces are flattened; and between them is a sharp spine, to which the strong ligament extended between the two bones of the fore arm is fixed. On the anterior surface, at a distance from its head nearly equal to one-third the length of the bone, is the orifice of the canal for the medullary vessels, which has a direction obliquely upwards.

Towards the lower end, the radius becomes broader and flatter, especially on its forepart, where the pronator quadratus muscle is situated. Its back part, at this end, has a flat strong ridge in the middle, and fossæ on each side. In a small groove, immediately on the inside of the ridge, the tendon of the extensor of the last joint of the thumb plays. In a large one, inside of this, the tendons of the indicator, and of the common extensor muscles of the fingers pass. On the outside of the ridge there is a broad depression, which seems again subdivided, where the two tendons of the extensor carpi radialis are lodged. The external side of this end of the radius is also hollowed by the extensors of the first and second joint of the thumb. The ridges at the sides of the grooves, in which the tendons play, have an annular ligament fixed to them, by which the several sheaths for the tendons are formed. The forepart of this end of the

radius is also depressed, where the flexors of the fingers and flexor carpi radialis pass, The internal side is formed into a semilunated smooth cavity, lined with a cartilage, for receiving the lower end of the ulna. The lowest part of the radius is formed into an oblong cavity; in the middle of which is a small transverse rising, gently hollowed, for lodging mucilaginous glands; while the rising itself is insinuated into the conjunction of the two bones of the wrist that are received into the cavity. The external side of this articulation is defended by a remarkable process of the radius, from which a ligament passes to the wrist; and this structure resembles that of the styloid process of the ulna with its ligament.

The ends of both the bones of the fore arm being thicker than the middle, and the radius being curved, there is a considerable distance between the bodies of these bones; in the larger part of which a strong tendinous, but thin ligament, is extended, to give a sufficient surface for the origin of the numerous fibres of the muscles situated here, that are so much sunk between the bones as to be protected from injuries, to which they would otherwise be exposed. But this ligament is wanting near the upper end of the fore arm, where the supinator radii brevis and flexor digitorum profundus, are immediately connected.

As the head of the radius receives the tubercle of the os humeri, it is not only bended and extended along with the ulna, but may be moved almost half round its axis: and that this motion round its axis may be sufficiently large, the ligament of the articulation is extended, further down than ordinary, on the neck of this bone, before it is connected to it; and it is very thin at its upper and lower part, but makes a firm ring in the middle. This bone is also joined to the ulna by a double articulation: for above, a tubercle of the radius plays in a socket of the ulna;

whilst below, the radius gives the socket, and the ulna the tubercle. But then the motion performed at the two ends is very different: for, at the upper end, the radius does little more than turn round its axis; while at the lower end, it moves nearly half round the cylindrical end of the ulna; and, as the hand is articulated and firmly connected here with the radius, they must move together. When the palm is turned uppermost, the radius is said to perform *supination:* when the back of the hand is above, it is said to be *prone.* But then the quickness and large extent of these two motions are assisted by the ulna, which, as was before observed, can move with a kind of small rotation on the sloping sides of the pulley. This rocking motion, though very inconsiderable in the elbow joint itself, is conspicuous at the lower end of such a long bone; and the strong ligament connecting this lower end to the carpus, makes the hand more readily obey these motions.

The Hand.

The *hand* comprehends the whole structure, from the end of the radius to the points of the fingers. Its back part is convex, for greater firmness and strength; and it is concave before, for containing more surely and conveniently such bodies as we take hold of. One half of the hand has an obscure motion in comparison of what the other has; it serves as a base to the moveable half, which can be extended back very little farther than to a straight line with the fore arm, but can be considerably bent forwards.

The *hand* consists of the *carpus* or wrist; *meta-carpus*, or part adjoining the wrist; and the *fingers*, among which the thumb is reckoned.

Carpus.

No part of the skeleton is more complex than the carpus. The following description will therefore be of little use to a young

student, unless the bones are before him when he is reading it. Great advantage will be derived from examining two sets of carpal bones; each set belonging to the same side. In one of these sets the bones should be connected by their natural ligaments; but the two rows separated from each other. The bones of the o her set should be accurately cleaned, so that their forms and surfaces may be examined.

The *carpus* is composed of eight small bones, arranged in two rows; one of which rows is attached to the bones of the fore arm, and the other to the body of the hand.

These bones are named from their figure, and shall be mentioned in the order in which they occur, beginning with the row next to the fore arm; and with the external bone in each row.

They are, *Os Scaphoides*, *Lunare*, *Cuneiforme*, *Pisiforme*, *Os Trapezium*, *Trapezoides*, *Magnum*, and *Unciforme.*

First Row.

Os scaphoides is the largest of the eight, excepting one. It is convex above, concave and oblong below; from which small resemblance to a boat, it has got its name. Its smooth convex surface is divided by a rough middle fossa, which runs obliquely across it. The upper largest division is articulated with the radius. The common ligament of the joint of the wrist is fixed into the fossa; and the lower division is joined to the trapezium and trapezoides. The concavity receives more than half of the round head of the os magnum. The internal side of this hollow is formed into a semilunar plane to be articulated with the following bone. The external, posterior, and anterior edges are rough, for fixing the ligaments that connect it to the surrounding bones.

Os lunare has a smooth convex upper surface, by which it is articulated with the radius. The external side, which gives the name to the bone, is in the

form of a crescent, and is joined with the scaphoid: the lower surface is hollow, for receiving part of the head of the os magnum. On the inside of this cavity is another smooth, but narrow, oblong sinuosity, for receiving the upper end of the unciforme: and on the inside of this a small convexity is found, for its connexion with the os cuneiforme. Between the great convexity above and the first deep inferior cavity, there is a rough fossa, in which the circular ligament of the joint of the wrist is fixed.

Os cuneiforme is broader above, and towards the back of the hand, than it is below and forwards; which gives it the resemblance of a wedge. The superior slightly convex surface is included in the joint of the wrist, being opposed to the lower end of the ulna. Below this the cuneiforme bone has a rough fossa, wherein the ligament of the articulation of the wrist is fixed. On the external side of this bone, where it is contiguous to the os lunare, it is smooth and slightly concave. Its lower surface, where it is contiguous to the os unciforme, is oblong, somewhat spiral, and concave. Near the middle of its anterior surface a circular plane appears, where the os pisiforme is sustained.

Os pisiforme is almost spherical, except one circular plane, or slightly hollowed surface, which is covered with cartilage for its motion on the cuneiforme bone, from which its whole rough body is prominent forwards into the palm; having the tendon of the flexor carpi ulnaris, and a ligament from the styloid process of the ulna, fixed to its upper part; the transverse ligament of the wrist is connected to its external side; ligaments extended to the unciforme bone, and to the os metacarpi of the little finger, are attached to its lower part; the abductor minimi digiti has its origin from its forepart; and, at the external side

of it, a small depression is formed, for the passage of the ulnar nerve.

Second Row.

Trapezium has four unequal sides and angles in its back part, from which it has got its name. Above, its surface is smooth, slightly hollowed, and semicircular, for its conjunction with the os scaphoides. Its internal side is an oblong concave square, for receiving the following bone. The inferior surface is formed into a pulley; which faces obliquely outwards and downwards when the palm presents forward. On this pulley the first bone of the thumb is moved. At the internal side of the pulley, a small oblong smooth surface is formed by the os metacarpi indicis. The forepart of the trapezium is prominent in the palm, and near to the internal side has a sinuosity in it, where the tendon of the flexor carpi radialis is lodged on the ligamentous sheath of which the tendon of the flexor longus pollicis manus plays: near this the bone is scabrous, where the transverse ligament of the wrist is connected, the abductor and the flexor brevis pollicis have their origin, and ligaments go out to the first of the thumb.

Os trapezoides, so called from the irregular quadrangular figure of its back part, is the smallest bone of the wrist except the pisiforme. The figure of it is an irregular cube. It has a small hollow surface above, by which it joins the scaphoides; a long convex one externally, where it is contiguous to the trapezium; a small internal concavity, for its conjunction with the os magnum; and an inferior convex surface, the edges of which are, however, so raised before and behind, that a sort of pulley is formed, where it sustains the os metacarpi indicis.

Os magnum, so called because it is the largest bone of the carpus, is oblong, having four quadran-

gular sides, with a round upper end, and a triangular plane one below. The round head is divided by a small rising, opposite to the connexion of the os scaphoides and lunare, which together form the cavity for receiving it. On the outside a short plane surface joins the os magnum to the trapezoides. On the inside is a long narrow concave surface, where it is contiguous to the os unciforme. The lower end, which sustains the metacarpal bone of the middle finger, is triangular, slightly hollowed, and farther advanced on the external side than on the internal, having a considerable oblong depression made on the advanced outside by the metacarpal bone of the forefinger; and generally there is a small mark of the os metacarpi digiti annularis on its internal side.

Os unciforme has got its name from a thin broad process that stands out from it forwards into the palm, and is hollow for affording passage to the tendons of the flexors of the fingers. To this process also the transverse ligament is fixed that binds down and defends these tendons; and the flexor and abductor muscles of the little finger have part of their origin from it. The upper plane surface is small, convex, and joined with the os lunare: the external side is long, and slightly convex, adapted to the contiguous os magnum. The internal surface is oblique, and irregularly convex, to be articulated with the cuneiforme bone. The lower end is divided into two concave surfaces; the internal is joined with the metecarpal bone of the little finger; and the external one is fitted to the metacarpal bone of the ring finger.

The nature of the carpus will be best understood by studying the bones placed together, in their natural order, in the two rows.

When thus placed they compose a structure of an oblong form, whose greatest length extends across the wrist and forms a concavity in front, while it is convex posteriorly.

Two bones of the first row, viz. the scaphoides and lunare, form an oblong convex surface, which has a transverse position with respect to the arm, and applies to the concave surface at the end of the radius. These surfaces are particularly calculated for flexion and extension, and also for a considerable motion to each side: and by a succession o these flexures, in different directions, the hand performs a circular motion, although it cannot perform at this joint, a rotation, or revolution on the axis of the carpus.

The under surface of these bones has a deep concavity, which is composed by the scaphoides, lunare and cuneiforme, and receives a prominence of the second row. It also presents a convex surface, formed by the scaphoides, which is received by the second row.

The upper surface of the second row, which is concerned in this articulation, is very irregular; it has a head formed by the magnum and unciforme, which penetrates deeply into the cavity of the first row. On the outside of this head the trapezium and trapezoides form a surface which receives the projecting part of the scaphoides; so that the first row receives, and is received by the second, and the two surfaces are well calculated for moving to a certain extent, in the way of flexion and extension, upon each other.

The lower surface of the second row, which is connected to the metacarpal bones, appears like the side of an arch, which is partly induced by the wedge-like form of the two bones in the centre; viz. the trapezoides and the magnum. When the hand hangs by the side, and the palm is forward, all of this surface presents downwards, except that portion of it which is formed by the trapezium. This bone is placed obliquely between the two rows, and its

surface for supporting the thumb presents obliquely downwards and outwards.

The trapezoides supports the forefinger, the magnum the middle finger.

The scaphoides and the trapezium are very prominent at the external side of the anterior concave surface of the corpus; and the unciforme process, and the os pisiforme on the internal.

The Metacarpus

Consists of four bones which sustain the fingers. Each bone is long and round, with its ends larger than its body. The upper end, which some call the base, is flat and oblong, inclining somewhat to the wedge-like form, without any considerable head or cavity, but it is however somewhat hollowed, for the articulation with the carpus. It is made flat and smooth on the sides where these bones are contiguous to each other. Their bodies are flattened on their back part, particularly below the middle, by tendons of the extensors of the fingers. The anterior surface of these bodies is a little convex, especially in their middle; along which a sharp ridge stands out, separating the musculi interossei placed on each side of these bones, which are there made flat and plain by these muscles.

Their lower ends are raised into large oblong smooth heads, whose greatest extent is forwards from the axis of the bone. At the forepart of each side of the root of each of these heads, one of two tubercles stand out, for fixing the ligaments that go from one metacarpal bone to another, to preserve them from being drawn asunder. Around the heads a rough ring may be remarked, for the capsular ligaments of the first joints of the fingers to be fixed to; and both sides of these heads are flat, by pressing on each other.

The *substance* of the metacarpal bones is the same with that of all long bones.

The metacarpal bones are *joined* above to the bones of the carpus, and to each other, by surfaces almost flat. These connexions do not admit of much motion. The articulation of the round heads, at their lower ends, with the cavities of the first bones of the fingers, will soon be described.

The concavity on the forepart of the metacarpal bones, and the position of their bases on the arched carpus, cause them to form a hollow in the palm of the hand, which is often useful to us. The spaces between them lodge muscles, and their small motion makes them fit supporters for the fingers to play on.

Though the ossa metacarpi so far agree, yet they may be distinguished from each other by the following marks.

The *metacarpal bone of the forefinger* is generally the longest. Its base, which is articulated with the os trapezoides, is hollow in the middle. The small ridge on the external side of this oblong cavity is smaller than the one opposite to it, and is made flat on the side by the trapezium. The internal ridge is also smooth, and flat on its ulnar side, for its conjunction with the os magnum; immediately below which a semicircular smooth flat surface shows the articulation of this to the second metacarpal bone. The back part of this base is flattened where the long head of the extensor carpi radialis is inserted, and its forepart is prominent where the tendon of the flexor carpi radialis is fixed. The tubercle at the internal root of its head is larger than the external. Its base is so firmly fixed to the bone it is connected with, that it has no motion.

The *metacarpal bone of the middle finger* is generally the second in length; but often it is as long as the

former: sometimes it is longer; and it frequently appears only to equal the first by the os magnum being farther projected downwards than any other bone of the wrist. Its base is a broad superficial cavity, slanting inwards: the external posterior angle of which is so prominent, as to have the appearance of a process. The external side of this base is made plane in the same way as the external side of the former bone, while its internal side has two hollow circular surfaces, for joining the third metacarpal bone; and between these surfaces there is a rough fossa, for the adhesion of a ligament, and lodging mucilaginous glands. The extensor carpi radialis brevior is inserted into the back part of this base. The two sides of this bone are almost equally flattened; but the ridge on the forepart of the body inclines inwards. The tubercles at the forepart of the root of the head are equal. The motion of this bone is very little more than that of the former; and therefore these two firmly resist bodies pressed against them by the thumb or fingers, or both.

The *metacarpal bone of the ring finger* is shorter than the second metacarpal bone. Its base is semicircular and convex, for its conjunction with the os unciforme. On its external side are two smooth convexities, and a middle fossa, adapted to the second metacarpal bone. The internal side has a triangular smooth concave surface to join it with the fourth one. The anterior ridge of its body is situated more to the inside than to the outside. The tubercles near the head are equal. The motion of this third metacarpal bone is greater than the motion of the second.

The *metacarpal bone of the little finger* is the smallest and sharpest. Its base is irregularly convex, and rises slanting inwards. Its external side is exactly adapted to the third metacarpal bone. The internal has no smooth surface, because it is not contiguous

to any other bone; but it is prominent where the extensor carpi ulnaris is inserted. As this metacarpal bone is furnished with a proper moving muscle, has the plainest articulation, is most loosely connected and least confined, it not only enjoys a much larger motion than any of the rest, but draws the third bone with it, when the palm of the hand is to be made hollow by its advancement forwards, and by the prominence of the thumb opposite to it.

Thumb and fingers.

The *thumb* and *four fingers* are each composed of three bones.

The THUMB is situated obliquely in respect to the fingers; neither opposite directly to them, nor in the same plane with them. All its bones are much thicker and stronger in proportion to their length, than the bones of the fingers are: which is extremely necessary, as the thumb counteracts all the fingers.

The first bone of the thumb has its base adapted to the peculiar articulating surface of the trapezium: for, in viewing it from one side to the other, it appears convex in the middle; but when viewed from behind forwards, it is concave there. The edge at the forepart of this base is extended farther than any other part; and round the back part of the base a rough fossa may be seen, for the connexion of the ligaments of this joint. The body and head of this bone are of the same shape as the ossa metacarpi; only that the body is shorter, the head flatter, and tubercles at the forepart of its root larger.

The articulation of the upper end of this bone is remarkable: for, though it has protuberances and depressions adapted to the double pulley of the trapezium, yet it enjoys a circular motion, as the joints do where a round head of the one plays in the orbicular socket of another: it is however more confined,

and less expeditious, but stronger and more secure than such joints generally are.

The second bone of the thumb has a large base formed into an oblong cavity, whose greatest length is from one side to the other. Round it several tubercles may be remarked, for the insertion of ligaments. Its body is convex, or half round behind; but flat before, for lodging the tendon of the long flexor of the thumb, which is tied down by ligamentous sheaths, that are fixed on each side to the angle at the edge of this flat surface. The lower end of this second bone has two lateral round protuberances, and a middle cavity, whose greatest extent of smooth surface is forwards and backwards.

The articulation of the upper end of this second bone would seem calculated for motion in all directions; yet, on account of the strength of its lateral ligaments, the oblong figure of the joint itself, and mobility of the first joint, it only allows flexion and extension; and these are generally much confined.

The third bone of the thumb is the smallest, with a large base, whose greatest extent is from one side to the other. This base is formed into two cavities and a middle protuberance, to be adapted to the pulley of the former bone. This bone becomes gradually smaller, till near the lower end, where it is a little enlarged, and has an oval scabrous edge. Its body is rounded behind, but is flatter than in the former bone, for sustaining the nail. It is flat and rough before, by the insertion of the flexor longus pollicis.

The motion of this third bone is confined to flexion and extension.

The regular arrangement of the bones of the FINGERS in three rows, has obtained for them the name of the three *phalanges*. All of them have half round convex surfaces, covered with an aponeurosis, formed

by the tendons of the extensors, lumbricales, and interossei, and placed directly backwards, for their greater strength; and their flat concave part is forwards, for taking hold more surely, and for lodging the tendons of the flexor muscles. The ligaments for keeping down these tendons are fixed to the angles that are between the convex and concave sides.

The bones of the first phalanx of the fingers answer to the description of the second bone of the thumb; only that the cavity in their base is not so oblong; nor is their motion on the metacarpal bones so much confined; for they can move laterally or circularly, the forefinger in particular, but have no rotation, or a very small degree of it, round their axis.

The second bone of the fingers has its base formed into two lateral cavities, and a middle protuberance: while the lower end has two lateral protuberances and a middle cavity; therefore it is joined at both ends in the same manner; which none of the bones of the thumb are.

The third bone differs nothing from the description of the third bone of the thumb, except in the general distinguishing marks; and therefore the second and third phalanx of the fingers enjoy only flexion and extension.

All the difference of the *phalanges* of the several fingers consists in their magnitude. The bones of the *middle finger* being the longest and largest; those of the *forefinger* come next to these in thickness, but not in length, for those of the *ring finger* are a little longer. The *little finger* has the smallest bones. Which disposition is the best contrivance for holding the largest bodies; because the longest fingers are applied to the middle largest periphery of such substances as are of a spherical figure.

SECTION IV.

The Inferior Extremities.

The inferior extremities consist of the Thigh, Leg, and Foot.

The Thigh.

Consists of one bone only; the *os femoris*, which is very strong, and larger than any other in the skeleton. It is nearly cylindrical in the middle, and slightly curved. The upper extremity is a spherical head, connected to the body of the bone by a neck. The lower extremity is much larger than the body, and is formed into two condyles.

The upper end of this bone is not continued in a straight line with the body of it, but the axis of it inclines obliquely inwards and upwards, whereby the distance between these two bones at their upper part is considerably increased. The head is the greater portion of a sphere. Towards its lower internal part a round rough spongy pit is observable, where the strong ligament, commonly, but inaccurately called the *round one*, is fixed, to be extended from thence to the lower internal part of the receiving cavity, where it is considerably broader than near to the head of the thigh bone. The neck of the os femoris has a great many large holes, into which the fibres of the strong ligament, continued from the capsular, enter, and are thereby firmly united to it; and round the root of the neck, where it rises from the bone, a rough ridge is found, where the capsular ligament of the articulation itself is connected. Below this root, a large unequal protuberance, called *trochanter major*, stands out; the external convex part of which is distinguished into three different sur-

faces; whereof the one on the upper and front part is scabrous and rough, for the insertion of the glutæus minimus; the superior one is smooth, and has the glutæus medius inserted into it; and the one behind is made flat and smooth, by the tendon of the glutæus maximus passing over it. The upper edge of this process is sharp and pointed at its back part, where the glutæus medius is fixed; but forwards it is more obtuse, and under it is a depression, into which some of the muscles which rotate the thigh outwards, are fixed. From the posterior prominent part of this great trochanter, a rough ridge runs backwards and downwards, into which the quadratus is inserted. In the deep hollow, at the internal upper side of this ridge, the obturator externus is implanted. More internally, a conical process, called *trochanter minor*, rises, for the insertion of the musculus psoas and iliacus internus; and the pectineus is implanted into a rough hollow below its internal root. The muscles inserted into these processes being the principal instruments of the rotatory motion of the thigh, have occasioned the name of *trochanters* to be given to these processes.

The body of the os femoris is convex on the forepart and concave behind; which enables us to sit without leaning to much on the posterior muscles.

On the posterior concave surface is a broad rough ridge called *linea aspera*, which commences near the great trochanter, and continues downwards, more than two-thirds of the length of the bone, when it divides into two ridges which descend towards each condyle. The internal of these ridges is the most smooth; and the space between them is nearly flat. Near the end of each of these ridges, a small smooth, protuberance may often be remarked, where the two heads of the external gastrocnemius muscle take their rise; and from the forepart of the internal

tubercle, a strong ligament is extended to the inside of the tibia.

The lower end of the os femoris is larger than any other part of it and is formed into two great protuberances, one on each side, which are called its *condyles:* between them a considerable cavity is found, especially at the back part, in which the crural vessels and nerves lie. The internal condyle is longer than the external, which must happen from the oblique position of this bone, to give less obliquity to the leg. These processes are of an oblong form, and are placed obliquely with respect to each other; being in contact before and separated to a considerable distance behind.

They form in front a smooth pulley-like surface, the external side of which is highest, on which the patella moves.

Below, they are flat; and posteriorly, they are regularly convex.

Between these convex portions is a rough cavity, from which the crucial ligament arises, to be attached to the tibia. Round the lower end of the thigh bone, large holes are found, into which the ligaments for the security of the joint are fixed, and blood vessels pass to the internal substance of the bone.

The thigh bone being articulated above with the acetabulum of the os innominatum, which affords its round head a secure and extensive play, can be moved to every side: but it is restrained in its motion outwards, by the high brims of the cavity, and by the round ligament; for otherwise the head of the bone would have been frequently thrust out at the breach of the brims on the inside, which allows the thigh to move considerably inwards. The body of this bone enjoys little or no rotatory motion, though the head most commonly moves round its own axis; because the oblique direction of the neck and head,

from the bone, is such, that the rotary motion of the head can only bring the body of the bone forwards and backwards. Nor is the head, as in the arm, ever capable of being brought to a straight direction with its body; so far, however, as the head can move within the cavity backwards and forwards, the rest of the bone may have a partial rotation.

From the oblique position of these bones it results, that there is a considerable distance between them above, while the knees are almost contiguous. Sufficient space is thereby left for the external parts of generation, for the two great outlets of urine and fæces, and for the large thick muscles that move the thigh inwards. At the same time this situation of the thigh bones renders our progression quicker, surer, straighter, and in less room: for, had the knees been at a greater distance from each other, we must have been obliged to describe some part of a circle with the trunk of our body in making a long step; and when one leg was raised from the ground, our centre of gravity would have been too far from the base of the other, and we should consequently have been in danger of falling; so that our steps would neither have been straight nor firm, nor would it have been possible to walk in a narrow path, had our thigh bones been otherwise placed. In consequence, however, of the weight of the body bearing so obliquely on the joint of the knee by this situation of the thigh bones, weak rickety children become knock-kneed.

The Leg

Is composed of the two bones, the TIBIA and FIBULA.

The patella, being evidently appropriated to the knee joint, may be regarded as common, both to the thigh and leg.

The Tibia

Is the long thick triangular bone, situated at the internal part of the leg, and continued in almost a straight line from the thigh bone. The name is derived from its resemblance to the ancient musical instrument.

The upper end of the tibia is large, bulbous, and spongy. It has a horizontal surface, divided into two cavities, by a rough irregular protuberance, which is hollow at its most prominent part, as well as before and behind. The anterior of the two ligaments that compose the great crucial is inserted into the middle cavity; and the depression behind receives the posterior ligament. The two broad cavities at the sides of this protuberance are not equal: for the internal is oblong and deep, to receive the internal condyle of the thigh bone; while the external is more superficial and round, for the external condyle. In each of these two cavities of a recent subject, a semilunar cartilage is placed, which is thick at its convex edge, and becomes gradually thinner towards the concave or interior edge. The thick convex edge of each cartilage is connected to the capsular and other ligaments of the articulation; but so near to their rise from the tibia, that the cartilages are not allowed to change their places; while their narrow ends are fixed at the insertion of the strong cross ligament into the tibia, and seem to have their substance united with it; therefore a circular hole is left between each cartilage and the ligament, in which the most prominent convex part of each condyle of the thigh bone moves. The circumference of these cavities is rough and unequal, for the firm connexion of the ligaments of the joint. Immediately below the edge, at its back part, two

rough flattened protuberances stand out; into the internal, the tendon of the semimembranosus muscle is inserted; and a part of the cross ligament is fixed to the external. On the outside of this last tubercle, a smooth slightly-hollowed surface is formed by the action of the poplitæus muscle.

Before the forepart of the upper end of the tibia, a large rough protuberance rises, to which the strong tendinous ligament of the patella is fixed. On the internal side of this, there is a broad scabrous slightly-hollowed surface, to which the internal long ligament of the joint, the aponeurosis of the vastus internus, and the tendons of the semitendinosus, gracilis, and sartorius, are fixed. Below the external edge of the upper end of the tibia, there is a flat circular surface, covered in a recent subject with cartilage, for the articulation of the fibula. The body of the tibia is triangular. The anterior angle is very sharp, and is commonly called the *spine* or *shin*. This ridge is not straight; but turns first inwards, then outwards, and lastly inwards again. The plane internal side is smooth and equal, being little subjected to the actions of muscle; but the external side is hollowed above by the tibialis anticus, and below by the extensor digitorum longus and extensor pollicis longus. The two angles behind these sides are rounded by the action of the muscles; the posterior side comprehended between them is not so broad as those already mentioned, but is more oblique and flattened by the action of the tibialis posticus and flexor digitorum longus. A little above the middle of the bone, the internal angle terminates, and the bone is made round by the pressure of the musculus solæus. Near to this, the passage of the medullary vessels is seen slanting obliquely downwards.

The lower end of the tibia is hollowed, with a small protuberance in the middle. The internal side

of this cavity, which is smooth, and in a recent subject is covered with cartilage, is extended into a considerable process, commonly named *malleolus internus;* the point of which is divided by a notch, and from it ligaments are sent out to the foot. The external side of this end of the tibia has a rough irregular cavity formed in it for receiving the lower end of the fibula. The posterior side has two lateral grooves, and a small middle protuberance. In the internal depression, the tendons of the musculis tibialis posticus and flexor digitorum longus are lodged; and in the external, the tendon of the flexor longus pollicis plays. From the middle protuberance, ligamentous sheaths go out, for tying down these tendons.

The Fibula

Is the small bone, placed on the outside of the leg, opposite to the external angle of the tibia; the shape of it is irregular.

The head of the fibula has a circular surface formed on its inside, which, in a recent subject, is covered with a cartilage; and it is so closely connected to the tibia by ligaments, as to allow only a very small motion backwards and forwards. This head is protuberant and rough on its outside, where a strong round ligament and the musculus biceps are inserted: and, below the back part of its internal side, a tubercle may be remarked; that gives rise to the strong tendinous part of the solæus muscle.

The body of this bone is a little crooked inwards and backwards: which figure is owing to the actions of the muscles. The sharpest angle of the fibula is forwards; on each side of which the bone is considerably, but unequally, depressed by the bellies of the several muscles that rise from or act upon it. The external surface of the fibula is depressed obliquely from above downwards and backwards, by

the two peronæi. Its internal surface is unequally divided into two narrow longitudinal planes, by an oblique ridge extended from the upper part of the anterior angle. To this ridge the ligament stretched between the two bones of the leg is connected. The anterior of the two planes is very narrow above, where the extensor longus digitorum and extensor longus pollicis arise from it: but is broader below, where it has the print of the nonus vesalii. The posterior plane is broad and hollow, giving origin to the larger share of the tibialis posticus. The internal angle of this bone has a tendinous membrane fixed to it, from which some fibres of the flexor digitorum longus take their rise. The posterior surface of the fibula is the plainest and smoothest; but is made flat above by the solæus, and is hollowed below by the flexor pollicis longus. In the middle of this surface, the canal for the medullary vessels may be seen slanting downwards.

The lower end of the fibula is extended into a spongy oblong head; on the inside of which is a convex, irregular, and frequently a scabrous surface, that is received by the external hollow of the tibia, and so firmly joined to it, by a very thin intermediate cartilage and strong ligaments, that it scarce can move. Below this the fibula is stretched out into a smooth coronoid process, covered with cartilage on its internal side, and is there contiguous to the outside of the first bone of the foot, the astragalus, to secure the articulation. This process, named *malleolus externus*, being situated farther back than the internal malleolus, and in an oblique direction, obliges us naturally to turn the forepart of the foot outwards. At the lower internal part of this process, a spongy cavity for mucilaginous glands may be remarked; from its point ligaments are extended to the bones of the foot, viz. the astragalus, os calcis, and os

naviculare; and from its inside short strong ones go out to the astragalus. On the back part of it a sinuosity is made by the tendons of the peronæi muscles. When the ligament extended over these tendons from the one side of the depression to the other is broken, stretched too much, or made weak by a sprain, the tendons frequently start forwards to the outside of the fibula.

The conjunction of the upper end of the fibula with the tibia is by plane surfaces tipped with cartilage; and at its lower end the cartilage seems to glue the two bones together; not, however, so firmly in young people, but that the motion at the other end is very observable. In old subjects, the two bones of the leg are sometimes united by anchylosis at their lower ends.

The principal use of this bone is to afford origin and insertion to muscles; and to give a particular direction to their tendons. It likewise assists to make the articulation of the foot more secure and firm, and to complete the hinge-like joint at the ankle. The ends of the tibia and fibula being larger than their middle, a space is here left, which is filled up with a ligament similar to that which is extended between the bones of the fore arm; and which is also discontinued at its upper part, where the tibialis anticus immediately adheres to the solæus and tibialis posticus; but every where else it gives origin to muscular fibres.

The Patella or Rotula

Is the small flat bone situated at the forepart of the joint of the knee. Its shape resembles the common figure of the heart with its point downwards. The anterior convex surface of the rotula is pierced by a great number of holes, into which are inserted the fibres of the strong ligament, that is spread over it.

Its posterior surface is smooth, covered with cartilage, and divided by a middle convex ridge into two cavities, of which the external is largest; and both are exactly adapted to the pulley of the os femoris, on which they are placed in the most ordinary unstraining postures of the legs: but when the leg is much bent, the patella descends far down on the condyles; and when the leg is fully extended, the patella rises higher in its upper part than the pulley of the thigh bone. The plane smooth surface is surrounded by a rough prominent edge, to which the capsular ligament adheres. Below, the point of the bone is scabrous, where the strong tendinous ligament from the tubercle of the tibia is fixed. The upper horizontal part of this bone is flattened and unequal, where the tendons of the extensors of the leg are inserted.

The substance of the patella is cellular, with very thin firm external plates; but when these cells are so small, and such a quantity of bone is employed in their formation, that scarce any bone of its bulk is so strong. But notwithstanding this strength, it is sometimes broken by the violent straining effort of the muscles.

The principal motions of the knee joint are flexion and extension. In the former of these, the leg may be brought to a very acute angle with the thigh, by the condyles of the thigh bones being round and made smooth far backwards. In performing this, the patella is pulled down by the tibia. When the leg is to be extended, the patella is drawn upwards, consequently the tibia forwards, by the extensor muscles; which, by means of the protuberant joint, and of this thick bone with its ligament, have the chord, with which they act, fixed to the tibia at a considerable angle, and act, on that account, with advantage; but they are restrained from pulling the leg farther

than to a straight line with the thigh, by the posterior part of the cross ligament, that the body might be supported by a firm perpendicular column: for at this time the thigh and leg are as little moveable in a rotatory way, or to either side, as if they were one continued bone. But when the joint is a little bent, the rotula is not tightly braced, and the posterior ligament is relaxed; therefore this bone may be moved a little to either side, or with a small rotation in the superficial cavities of the tibia; which is done by the motion of the external cavity backwards and forwards, the internal serving as a sort of axis. Seeing then, one part of the cross ligament is situated perpendicularly, and the posterior part is stretched obliquely from the internal condyle of the thigh outwards, that posterior part of the cross ligament prevents the leg from being turned much inwards; but it could not hinder it from turning outwards almost round, was not that motion confined by the lateral ligaments of this joint, which can yield little.

This rotation of the leg outwards is of great advantage to us in crossing our legs, and turning our feet outwards, on several necessary occasions; though it is necessary that this motion should not be very large, to prevent frequent luxations here. While all these motions are performing, the part of the tibia that moves immediately on the condyles is that which is within the cartilaginous rings, which by the thickness on their outsides make the cavities of the tibia more horizontal, by raising their external side where the surface of the tibia slants downwards. By these means the motions of this joint are more equal and steady than otherwise they would have been. The cartilages being capable of changing a little their situation, contribute to the different motions and postures of the limb, and likewise make the motions larger and quicker.

The Foot.

The foot is divided into the *tarsus*, *metatarsus*, and *toes*.

The sole of the foot is necessarily described as the inferior part, and the side of the great toe as the internal.

Tarsus.

The *tarsus* consists of seven spongy bones; to wit, the *astragalus*, *os calcis*, *naviculare*, *cuboides*, *cuneiforme externum*, *cuneiforme medium*, and *cuneiforme inturnum*.

The *astragalus* is the uppermost of these bones. The *os calcis* is below the astragalus, and forms the heel. The *os naviculare* is in the middle of the internal side of the tarsus. The *os cuboides* is the most external of the row of four bones, at its forepart. The *os cuneiforme externum* is placed at the inside of the cuboid. The *cuneiforme medium* is between the external and internal cuneiforme bones; and the *internal cuneiforme* is at the internal side of the foot.

The upper part of the *astragalus* is formed into a large smooth head, which is slightly hollowed in the middle; and therefore resembles a superficial pulley, by which it is fitted to the lower end of the tibia. The internal side of this head is flat and smooth, to play on the internal malleolus. The external side has also such a surface, but larger, for its articulation with the external malleolus. Round the base of this head there is a rough fossa; and immediately before the head, as also below its internal smooth surface, we find a considerable rough cavity.

The lower surface of the astragalus is divided by an irregular deep rough fossa, which at its internal end is narrow, but gradually widens as it stretches obliquely outwards and forwards. The smooth surface, covered with cartilage, behind this fossa, is

large, oblong, extended in the same oblique situation with the fossa, and concave for its conjunction with the os calcis. The posterior edge of this cavity is formed by two sharp-pointed rough processes, between which is a depression made by the tendon of the flexor pollicis longus. The lower surface before the fossa is convex, and composed of three distinct smooth planes. The long one behind, and the exterior or shortest, are articulated with the heel bone; while the internal, which is the most convex of the three, rests and moves upon a cartilaginous ligament, that is continued from the os calcis to the os naviculare, without which ligament the astragalus could not be sustained, but would be pressed out of its place by the great weight it supports; and the other bones of the tarsus would be separated. Nor would a bone be fit here, because it must have been thicker than could conveniently be allowed; otherwise it would break, and would not prove such an easy bending base, to lessen the shock which is given to the body in leaping, running, &c.

The forepart of this bone is formed into a convex oblong smooth head, which is received by the os naviculare, and is placed obliquely; its longest axis inclining downwards and inwards. Round the root of this head, especially on the upper surface, a rough fossa may be remarked.

The astragalus is articulated above to the tibia and fibula, which together form one cavity. In this articulation, flexion and extension are the most considerable motions; the other motions being restrained by the malleoli, and by the strong ligaments which go out from the points of these processes, to the astragalus and os calcis. When the foot is bent, as it commonly is when we stand, no lateral or rotatory motion is allowed in this joint; for then the head of this astragalus is sunk deep between the malleoli,

and the ligaments are tense: but when the foot is extended, the astragalus can move a little to either side, and with a small rotation. By this contrivance the foot is firm, when the weight of the body is to be supported on it; and when a foot is raised, we are at liberty to direct it more exactly to the place we intend next to step upon.

The astragalus is joined below to the os calcis; and before to the os naviculare, in the manner to be explained when these bones are described.

The *os calcis* is the largest bone of the seven. Behind, it is formed into a large knob, commonly called the *heel*, the posterior surface of which is rough below for the insertion of what is called the tendo achillis, and oblique above to allow the heel to be depressed without pressing against the tendon. On the upper surface of the os calcis, there is an irregular oblong smooth convexity, adapted to the concavity at the back part of the astragalus; and beyond this a narrow fossa is seen, which divides it from two small concave smooth surfaces, that are joined to the forepart of the astragalus. The posterior of these smooth surfaces, which is the largest, is the upper surface of a process which projects inwards: and under it is a small sinuosity for the tendon of the flexor digitorum longus.

The external side of this bone is flat, with a superficial fossa running horizontally, in which the tendon of the musculus peronæus longus is lodged. The internal side of the heel bone is hollowed, for lodging the origin of the massa carnea, and for the safe passage of tendons, nerves, and arteries. Under the side of the internal smooth concavity, a particular groove is made by the tendon of the flexor pollicis longus; and from the thin protuberance of this internal side a cartilaginous ligament that supports the astragalus, goes out to the os naviculare; on which

ligament, and on the edge of this bone to which it is fixed, the groove is formed for the tendon of the flexor digitorum profundus.

The lower surface of this bone is flat at the back part, and immediately before this plane, there are two tubercles, from the internal of which the musculus abductor pollicis flexor digitorum sublimis, as also part of the aponeurosis plantaris, and of the abductor minimi digiti, have their origin; and the other part of the abductor minimi digiti and aponeurosis plantaris rises from the external. Before these protuberances, this bone is concave, for lodging the flexor muscles; and at its forepart, we may observe a rough depression, from which, and a tubercle behind it, the ligament goes out that prevents this bone from being separated from the os cuboides.

The forepart of the os calcis is formed into an oblong pulley-like smooth surface, which is circular at its upper external end, but is pointed below. The smooth surface is fitted to the os cuboïdes.

Though the surfaces by which the astragalus and os calcis are articulated, seem fit enough for motion; yet the very strong ligaments, by which these bones are connected, prevent much motion, and give firmness to this principal part of our base, which rests on the ground.

Os naviculare is somewhat oval. It is formed into an oblong concavity behind, for receiving the anterior head of the astragalus. The upper surface is convex. Below, the surface is very unequal and rough; but hollow for the safety of the muscles. Its internal extremity is very prominent. The abductor pollicis takes in part its origin from it, the tendon of the tibialis posticus is inserted into it, and to it two remarkable ligaments are fixed; the first is the strong one, formerly mentioned, which supports the astragalus; the second is stretched from this bone obliquely

across the foot, to the metatarsal bones of the middle toe, and of the toe next to the little one. On the outside of the os naviculare there is a semicircular smooth surface, where it is joined to the os cuboides. The forepart of this bone is covered with cartilage, and divided into three smooth planes, fitted to the three ossa cuneiformia.

The os naviculare and astragalus are joined as a ball and socket; and the naviculare moves in several directions in turning the toes inwards, or in raising or depressing either side of the foot, though the motions are greatly restrained by the ligaments which connect this to the other bones of the tarsus.

Os cuboides is an irregular cube. Behind, it is formed into an oblong unequal cavity, adapted to the forepart of the os calcis. On its internal side, there is a small semicircular smooth cavity, to join the os naviculare. Immediately before which, an oblong smooth plane is made by the os cuneiforme externum; below this the bone is hollow and rough. On the internal side of the lower surface, a round protuberance and fossa are found, where the musculus adductor pollicis has its origin. On the external side of this surface, there is a broad ridge running forwards and inwards, covered with cartilage; immediately before which a smooth fossa may be observed, in which the tendon of the peronæus primus runs upliquely across the foot. Before, the surface of the os cuboides is flat, smooth, and slightly divided into two planes, for sustaining the os metatarsi of the little toe, and of the toe next to it.

The form of the back part of the os cuboides, and the ligaments connecting the joint with the os calcis, both concur in allowing little motion in this part.

Os cuneiforme externum is shaped like a wedge, being broad and flat above, with long sides running obliquely downwards, and terminating in an edge.

The upper surface of this bone is an oblong square. The one behind is nearly a triangle, but not complete at the inferior angle, and is joined to the os naviculare. The external side is an oblong square divided as it were by a diagonal; the upper half of it is smooth, for its conjunction with the os cuboides: the other is a scabrous hollow, with a small smooth impression made by the os metatarsi of the toe next to the little one. The internal side of this bone is flattened before by the metatarsal bone of the toe next to the great one, and the back part is also flat and smooth where the os cuneiform medium is contiguous to it. The forepart of this bone is triangular, for sustaining the os metatarsi of the middle toe.

Os cuneiforme, or *minimum*, is still more exactly the shape of a wedge than the former. Its upper part is square; its internal side has a flat smooth surface, for its connexion with the adjoining bone; the external side is smooth and a little hollowed, where it is contiguous to the last described bone. Behind, this bone is triangular, where it is articulated with the os naviculare; and it is also triangular at its forepart, where it is contiguous to the os metatarsi of the toe next to the great one.

The broad thick part of the *os cuneiforme maximum*, or *internum*, is placed below, and the small thinner edge is above. The surface of this os cuneiforme behind, where it is joined to the os naviculare, is hollow, smooth, and of a circular figure below, but pointed above. The external side consists of two smooth and flat surfaces. With the posterior, that runs obliquely forwards and outwards, the os cuneiforme minimum is joined; and with the anterior, whose direction is longitudinal, the os metatarsi of the toe next to the great one is connected. The forepart of this bone is flat and smooth, for sustaining the os metatarsi of the great toe. The internal side is

scabrous, with two remarkable tubercles below, from which the musculus abductor pollicis rises, and the tibialis anticus is inserted into its upper part.

The three cuneiforme bones are all so secured by ligaments, that very little motion is allowed in any of them.

These seven bones of the *tarsus*, when joined, are convex above, and leave a concavity below, for lodging safely the several muscles, tendons, vessels, and nerves, that lie in the sole of the foot. In the recent subject, their upper and lower surfaces are covered with strong ligaments, which adhere firmly to them; and all the bones are so tightly connected by these and the other ligaments, which are fixed to the rough ridges and fossæ, that notwithstanding the many surfaces covered with cartilage, some of which are of the form of the very moveable articulations, no more motion is here allowed, than is necessary to prevent too great a shock of the fabric of the body in walking, leaping, &c. by falling on too solid a base. If the tarsus was one continued bone, it would likewise be much more liable to be broken, and the foot could not accommodate itself to the surfaces we tread on by becoming more or less hollow, or by raising or depressing either of its sides.

Metatarsus.

The *Metatarsus* is composed of five bones, which agree, in their general characters, with the metacarpal bones; but may be distinguished from them by the following marks: 1. They are longer, thicker, and stronger. 2. Their anterior round ends are not so broad, and are less in proportion to their bases. 3. Their bodies are sharper above and flatter on their sides, with their inferior ridge inclined more to the outside. 4. The tubercles at the lower part of the round head are larger.

The first or internal metatarsal bone is easily distinguished from the rest by its thickness. The one next to it is the longest, and with its sharp edge almost perpendicular. The others are shorter and more oblique, as their situation is more external. Which general remarks, with the description now to be given of each, may teach us to distinguish them from each other.

Os metatarsi pollicis is by far the thickest and strongest, as having much the greatest weight to sustain. Its base is oblong, irregularly concave, and of a semilunar figure, to be adapted to the os cuneiforme maximum. The inferior edge of this base is a little prominent and rough, where the tendon of the peronæus primus muscle is inserted. On its outside, an oblique circular depression is made by the second metatarsal bone. Its round head has generally on its forepart a middle ridge, and two oblong cavities, for the ossa sesamoidea; and on the external side a depression is made by the following bone.

Os metatarsi of the *second toe* is the longest of the five, with a triangular base supported by the os cuneiforme medium, and the external side produced into a process; the end of which is an oblique smooth plane, joined to the os cuneiforme externum. Near the internal edge of the base, this bone has two small depressions, made by the os cuneiforme maximum, between which is a rough cavity. Farther forwards we may observe a smooth protuberance, which is joined to a foregoing bone. On the outside of the base are two oblong smooth surfaces for its articulation with the following bone; the superior smooth surface being extended longitudinally, and the inferior perpendicularly, between which there is a rough fossa.

Os metatarsi of the *middle toe* is the second in length. Its base, supported by the os cuneiforme externum, is triangular, but slanting outwards, where

it ends in a sharp-pointed little process, and the angle below is not completed.

The internal side of this base is adapted to the preceding bone; and the external side has also two smooth surfaces covered with cartilage, but of a different figure; for the upper one is concave, and being round behind, turns smaller as it advances forwards; and the lower surface is a little smooth, convex, and very near the edge of the base.

Os metatarsi of the *fourth toe* is nearly as long as the former, with a triangular slanting base joined to the os cuboides, and made round at its external angle; having one hollow smooth surface on the outside, where it is pressed upon by the following bone; and two on the internal side, corresponding to the former bone; behind which is a long narrow surface impressed by the os cuneiforme externum.

Os metatarsi of the *little toe* is the shortest, situated with its two flat sides above and below, and with the ridges laterally. The base of it, part of which rests on the os cuboides, is very large, tuberous, and produced into a long-pointed process externally, where part of the abductor minimi digiti is fixed; and into its upper part the peronæus secundus is inserted. Its inside has a flat conoidal surface, where it is contiguous to the preceding bone.

When we stand, the fore ends of these metatarsal bones, and the os calcis, are our only supporters, and therefore it is necessary that they should be strong, and should have a confined motion.

The Toes.

The bones of the toes are nearly similar to those of the thumb and fingers; particularly the two of the great toe, which are precisely formed as the two last of the thumb; but their position, as respects the other toes, is not oblique; and they are proportionally

much stronger, because they are subjected to a greater force; for they sustain the force with which our bodies are pushed forwards by the foot behind at every stop we make; and on them principally the weight of the body is supported, when we are raised on our tiptoes.

The three bones in each of the other four toes, compared with those of the fingers, differ from them in these particulars. They are less, and smaller in proportion to their lengths. Their bases are much larger than their anterior ends. The first phalanx is proportionally much longer than the bones of the second and third, which are very short.

The toe next to the great one has the largest bones in all dimensions, and the bones of the other toes diminish according to the order of their position; those of the exterior being least.

The general Structure of the Foot.

The *foot* may be considered as an arch, of which the back part of the heel, and the anterior extremities of the metatarsal bones and the toes, are the abutments. The heel, or posterior abutment, is not so broad as the anterior, and is placed on the outside and not in the middle of the extremity of the arch. The process on the inside of the os calcis, which supports the astragalus, increases the breadth of the arch; and the os naviculare completes it. The arch thus constructed, does not appear very firm, and this apparent want of strength seems increased by the position of the anterior portion of the astragalus, a part of which is between the os calcis and os naviculare, and not supported by either. These bones however are firmly connected by ligaments, and one which passes from the os calcis to the os naviculare, under the forepart of the astragulus, gives effectual support to that bone.

The outside of the foot, formed by the os calcis, os cuboides, and the lesser metatarsal bone, does not partake much of the nature of an arch; for it is almost flat. As the internal side forms a considerable arch, the foot is to be considered as possessing a double convexity, viz. transversely, as well as longitudinally.

The great toe, from its internal situation, is the principal anterior abutment of the arch on the internal side of the foot; hence its great importance.

The astragalus, which is the basis of the tibia, and of course pressed by half of the weight of the body when we stand, appears to be in a situation which is very oblique, and imperfectly supported; and accordingly it has been completely forced from its position, by accidents in which the leg has been twisted or turned inward, and the foot prevented from turning with it. It is probable that this misfortune would often take place if the fibula did not previously yield, as in some of the cases of fracture of that bone near the external ankle.

One great object of this peculiar structure is, that the foot may yield in cases of violent and sudden pressure, as when we jump or fall upon the feet. The safety of the foot, and the facility of its ordinary movement, are not the only objects of its peculiar structure, but concussion of the whole body, and particularly of the brain, is thereby avoided to a certain degree.

This may be inferred from the fact that many persons suffer violent concussions, in consequence of falling upon other parts of the body, who are free from these effects when they fall upon the feet.

The Sesamoid Bones

Are seldom larger than half a pea. They are most commonly found at the second joint of the thumb, and

of the great toe; and are placed in pairs, especially at the great toe, between the tendons of the flexor muscles and the bones. In these situations they are convex externally, and on their internal surfaces they are concave and covered with cartilage.

They are also sometimes found between the heads of the gastrocnemius muscle and the condyles of the os femoris.

In the joints of the thumb and toe they appear to be very analogous to the patella.

The Extremities of the Fœtus.

In the upper extremity the clavicle is almost perfect at birth; but the acromion and coronoid processes of the scapula, as well as the head, are in a cartilaginous state.

Both ends of the os humeri are cartilaginous. They afterwards ossify in the form of epiphyses, and are united to the body of the bone.

The two bones of the fore arm are in the same situation.

There are no bones of the carpus; but in their situation is an equal number of cartilages, which resemble them exactly. These cartilages are separated from each other by synovial membranes, as the bones afterwards are. Each of them ossifies from a single point, except the unciforme.

The metacarpal bones, and the first bone of the thumb, have cartilages at each extremity, which afterwards become epiphyses.

The bones of the phalanges are likewise cartilaginous at each extremity. The extremities next to the hand are epiphyses; but it is probable that the other extremities ossify gradually from their centres.*

In the lower extremity, the head and neck and

* See Nesbit's Osteogeny, page 126.

two trochanters of the os femoris are cartilaginous, and form three epiphyses.

The other end of this bone is also cartilaginous, and constitutes but one epiphysis, notwithstanding its size; the ossification commencing in the centre.

At birth, the body of the os femoris is less curved than it becomes afterwards; and the angle formed by the neck of the bone is less obtuse than in the adult.

The patella is entirely cartilaginous at birth.

The two extremities of the tibia and fibula are also cartilaginous, and become epiphyses.

The astragalus and os calcis are somewhat ossified within, and have a large portion of cartilage exteriorly.

In place of the other bones of the tarsus, there are cartilages of their precise shape, which are as distinct from each other as the future bones are.

The state of the metatarsal bones, and the phalanges of the toes, resembles that of the bones of the hand.*

* Volehn Koyter, a disciple of Fallopius, has given to the profession one of the best accounts of Osteogeny, according to Lassus.—Ed.

SYSTEM OF ANATOMY.

PART II.

MYOLOGY.

CHAPTER I.

OF MUSCLES IN GENERAL.*

That soft, fibrous, red coloured substance, which constitutes so large a proportion of the volume of the more perfect animals, is called *Flesh* or *Muscle.*

By the contraction of this substance, the spontaneous motions of animals are produced; and on this account the fibres which compose it have long been regarded with particular attention.

Muscular fibres are not only arranged in those regular masses on the trunk and limbs of the body, which are so familiar to us by the name of *muscles*, but they also exist in some of the most important viscera, and produce the internal, as well as the external, motions of animals.

Muscular fibres are connected to each other by cellular membrane. This membrane surrounds each muscle; and its various lamina, gradually diminishing in thickness, pass between the different bundles of fibres, and the different fibres of which each muscle is composed.

* Muscles were first named according to their figure and situation in 1587 by Jacques Dubois, surnamed Sylvius, a member of the Faculty of Medicine in Paris.—Ed.

The fibres of muscles, when examined with magnifying glasses, appear to be composed of fibrillæ still smaller; and it has been supposed that this division of them extended beyond our powers of vision, even when assisted by microscopes: but so many errors have occurred in microscopical observations of very minute objects, and so much difference exists between the reports of different observers, that the subject at this time does not interest many persons; and very little attention is paid, by the anatomists and physiologists of the present day, to the opinions of those observers who supposed they had ascertained the structure of the ultimate fibrillæ.

These fibrillæ have been represented as simple hollow tubes, as a series of globular vesicles, as continuations of arteries, as termination of nerves, as structures of rhomboidal bodies, and finally, as cellular.*

It is supposed by one of the latest observers, who appears to be entiled to great attention,† that the muscular fibres are not thus minutely divided: that a single fibre, when separated from the adhering extraneous substances, and viewed in a powerful microscope, is a solid cylinder, formed of a pulpy substance, irregularly granulated, and covered by a portion of the reticular membrane.

The connexion of these fibres, with the *blood vessels* and *nerves*, is an important circumstance in the structure of muscles.

The arteries of muscles are very numerous; and they ramify minutely. They are accompanied by veins; and it appears by the successful labours of

* A statement of these descriptions, with reference to the publications in which they are contained, may be seen in the Elementa Physiologiæ of Hallar, vol. IV.

† Carlysle, in the Croonian Lecture, London Philosophical Transactions, 1805, Part I.

Ruysch, that when these arteries are fully injected, they not only communicate with the veins, but also pour out some of their contents in a dew-like effusion in the muscle.*

These vessels must terminate, not in the cavities of the muscular fibres, but, exterior to these fibres; otherwise the dew-like effusion would not be apparent; and it is probable that the red colour, which is so general in muscles, depends upon a portion of blood effused from these vessels, and not contained in them; for it has been observed by Bichat, that in drowned or strangled animals, black disoxygenated blood occupied all the vessels, while the florid colour of the muscles continued unchanged; which could not have been the case if the colour of the muscles was owing to blood in the vessels.

That the colour of the red muscles is owing to blood, is rendered certain by the fact that this colour may be completely washed away while the fibrous structure of the muscle remains unchanged. From this also it may be inferred, that the blood is exterior to the muscular fibre, and to the vessels likewise.

It is said by Sabatier that the colour will likewise be completely removed, by injecting a large quantity of water through the arteries; this does not invalidate the inferences drawn from the other facts; for the water effused from the extreme branches of the arteries must necessarily wash away the blood which was previously effused from the same branches.

The water with which muscles have been washed appears as if some blood had been mixed with it; it contains albumen and gelatine, with some fibrine, and a peculiar extractive substance, as well as the red colouring matter.

* See Ruysch's description of the 96th preparation in his Thesaurus Quartus; and of the 35th preparation in the Thesaurus Decimus.

The substance of the muscle, when thus separated from the above-mentioned matter by washing, appears to be of the same nature with the fibrine of the blood: and after boiling some time in the water, it seems, like that substance, to consist of brown insoluble fibres, which are brittle when dry.

When the great function of muscles is under consideration, nerves appear of more importance than blood vessels.

The *nerves* appropriated to muscles of voluntary motion are more numerous than those appropriated to any other parts, except the organs of sense. They subdivide into very fine fibrillæ; and it is the opinion of one of the latest observers, that these fibrillæ become soft and transparent, and finally blended with the reticular membrane which surrounds the muscular fibres.

It ought to be noted that muscules are indued with great sensibility, and that the smallest puncture cannot be made in them without exciting pain.

Thus arranged, the fibres of muscles are most generally attached to tendons, which are inserted into the bones these muscles are intended to move. They are also, in some cases, inserted into tendinous membranes, and other parts necessary to be moved; but in all such instances these parts are perfectly passive; and the motion in which they are concerned is altogether produced by the contraction of the muscular fibres.

Notwithstanding the great attention that has been paid to this important operation of muscular fibres, the immediate cause is yet unknown.

Muscular motion takes place under the following different circumstances:—

1st. When irritation or stimulus is applied directly to the muscular fibre.

2d. When irritation is applied to a nerve connected with the muscles.

3d. When it is induced by volition.

There are several causes of muscular action which cannot be arranged under either of these heads, although it is probable they are not essentially different; such as the motions of coughing and sneezing, of yawning, &c.

The immediate irritation of a muscle is effected by every mechanical process, which punctures, divides, lacerates or extends its fibres; by acrid, and perhaps other chemical and peculiar qualities of the substance applied to the muscles; by a sudden change of temperature; and by electricity and galvanism.

No satisfactory explanation has yet been made of the manner in which muscular contraction is excited, either by the above-mentioned agents, by irritation applied to a nerve, or by volition.

When a muscular fibre begins to contract, there is often the appearance of a slight tremour in it. It becomes hard and rigid: its length diminishes, and its diameter increases. If a muscle makes an effort to contract, when the parts to which its extremities are attached are prevented from moving towards each other, so that contraction cannot take place, the muscle will become hard and rigid notwithstanding.

It has often been inquired whether the whole bulk of a muscle is diminished or increased by its contraction. It now seems generally agreed that the bulk is not increased; and if there is any real diminution of the fibre itself, it is very small indeed.

The irritability of the muscular fibre, or its power of contracting upon the application of stimulus, exists in a greater degree in some muscular parts than others. It is suspended by the application of nar-

cotic substances; and it remains, in many cases, a short time after the vital functions have ceased.

In a majority of cases a general contraction seems to take place in the last moments of life; and after death the body is stiff in consequence of it; all the moveable parts being fixed in the precise situation in which they were when the vital motions ceased. The limbs being generally in a bended position at that time, if an attempt be made to extend them it will be very evident that the contracted state of the muscles impedes this extension. When this contraction is once overcome, the limbs continue perfectly flexible, and the muscles are ever after relaxed; but the force of contraction is sometimes so great that it will require a considerable exertion of strength to overcome it. This condition of the muscles, after death, although very common, is not universal: and some dead subjects are perfectly relaxed and flexible from the first cessation of the vital functions.

The force with which muscles contract exceeds greatly their inanimate power of cohesion. Thus a muscle, deprived of life, would be completely lacerated by a weight suspended from it, which it could readily raise by its contraction during life. This force of contraction is so great, that the tendo Achillis and the patella have been repeatedly broken by the mere power of the muscles inserted into them.

The rapidity with which the successive contractions of the same parts take place is extreme; and as a striking proof of it, the motions of the tongue, in rapid speaking or reading are referred to by physiologists.

The extent or degree of muscular contraction is, in some cases, very great. In proof of this it was stated by the second Monro, that crude mercury, which passes so readily through the intestines, could not be carried along any parts of them whose position happened to be perpendicular, (as the colon on the right

side when we stand,) unless the circular fibres of the intestine could contract behind it to such a degree as to close completely the cavity of that tube.

An interesting question may be proposed here,—Whether the power of motion, as above described, is exclusively enjoyed by muscular fibres; whether these fibres must be supposed to exist in all those parts of the body which occasionally perform contraction?

It has often been inferred, that parts were muscular because they were capable of contraction; but the question above ought to be decided affirmatively before such inferences can be properly made.

The sac of the tænia hydatigena appears to be a membrane of a peculiar structure, very different from muscle; yet it is as capable of contracting as if it were perfectly muscular.*

The membrane of the urethra does not appear to be muscular in its structure; and yet it has been seen to protrude a bougie, which had passed near to the neck of the bladder, in a way that indicated regular successive contraction, throughout its whole extent.

The question above stated may therefore be considered as not yet decided affirmatively.

Muscular fibres are situated very differently in different parts. They compose almost the whole substance of the heart, which is therefore called a hollow muscle. They also form one of the coats of the stomach and intestines of the urinary bladder.

In the muscles on the trunk and limbs, their arrangement is very various, being rectilinear, penniform, radiated, &c.

There are a great many short fibres, with an oblique direction, in some muscles of small volume; which have therefore great power and little motion.

* See the Croonian Lecture by Mr. Home; London Philosophical Transactions for 1795, Part I. page 204.

... Calomel
the Chloride of Mercury.
Hydrargyri Oxymurias. Cor. sublimate
the Bichloride of mercury
Acetas Hydrargyri - acetate mercury.
Hydrar: Sulphuretum nigrum
the Black sulphuret of mercury.
~~Hy~~drar: Sub-sulphas flavus. - The
Yellow sub-sulphate of Mercury. or
Turpeth Mineral
Hydrargyri Sulphuretum Rubrum.
The Red Sulphuret of mercury = Cinnabar.
Hydrar: Oxydum Rubrum. The
Red Oxyde of Mercury
Hydrar: Nitrico Oxydum. The
Red precipitate

4 Tests for ....

1. Lime Water
2. Ammoniacal Nitrate Silver
3. Ammoniacal Sulphate Copper
4th & best – Sulphuretted Hydrogen

Arsenious acid 38 or 1 atom Arsenic
& 16 or 2 Atoms Oxygen
54

Arsenic Acid — 38 – 1 atom Arsenic
& 24 – 3 atoms Oxygen
62

Black-flux is made by deflagrating a
mixture of the Bitartrate of Potash with
its weight of Nitre – the Nitric and
Tartaric acids undergo decomposition
and the solid is a mixture of pure Car-
bonate of Potash & Charcoal

1.9 Syr
01

CHAPTER II.

OF THE INDIVIDUAL MUSCLES.

Muscles of the Teguments of the Cranium.

The skin that covers the cranium is moved by a single broad digastric muscle, and one small pair.

1. *Occipito-Frontalis,*

Arises fleshy from the transverse protuberant ridge near the middle of the os occipitis laterally, where it joins with the temporal bone; and tendinous from the rest of that ridge backwards, opposite to the lateral sinus; it rises after the same manner on the other side. From thence it comes straight forwards, by a broad thin tendon, which covers the upper part of the cranium at each side, as low down as the attollens aurem, to which it is connected, as also to the zygoma, and covers a part of the aponeurosis of the temporal muscle; at the upper part of the forehead it becomes fleshy, and descends with straight fibres.

Inserted into the orbicularis palpebrarum of each side, and into the skin of the eyebrows, sending down a fleshy slip between them, as far as the compressor naris and levator labii superioris alæque nasi.

Use. Pulls the skin of the head backwards; raises the eyebrows upwards; and, at the same time, it draws up and wrinkles the skin of the forehead.

2. *Corrugator Supercilii,*

Arises fleshy from the internal angular process of the os frontis, above the joining of the os nasi, and

nasal process of the superior maxillary bone; from thence it runs outwards, and a little upwards.

Inserted into the inner and inferior fleshy part of the occipito-frontalis muscle, where it joins with the orbicularis palbebrarum, and extends outwards as far as the middle of the superciliary ridge.

Use. To draw the eyebrow of that side towards the other, and make it project over the inner canthus of the eye. When both act, they pull down the skin of the forehead, and make it wrinkle, particularly between the eyebrows.

Muscles of the Ear.

1. *Attollens Aurem.*

Arises thin, broad, and tendinous, from the tendon of the occipito-frontalis, from which it is almost inseparable, where it covers the aponeurosis of the temporal muscle.

Inserted into the upper part of the ear, opposite to the antihelix.

Use. To draw the ear upwards, and make the parts into which it is inserted tense.

2. *Anterior Auris,*

Arises thin and membranous near the posterior part of the zygoma.

Inserted into a small eminence on the back of the helix, opposite to the concha.

Use. To draw this eminence a little forwards and upwards.

3. *Retrahentes Auris,*

Arise, sometimes by three, but always by two, distinct small muscles, from the external and posterior part of the root of the mastoid process, immediately above the insertion of the sterno-cleido-mastoid muscle.

Inserted into that part of the back of the ear which is opposite to the septum that divides the scapha and concha.

Use. To draw the ear back, and stretch the concha.

Muscles of the Eyelids.

The palpebræ or eyelids, have one muscle common to both, and the upper eyelid one proper to itself.

1. *Orbicularis Palpebrarum,*

Arises, by a number of fleshy fibres, from the outer edge of the orbitar process of the superior maxillary bone, and from a tendon near the inner angle of the eye; these run a little downwards, then outwards, over the upper part of the cheek, below the orbit, covering the under eyelid, and surround the external angle, being loosely connected only to the skin and fat; run over the superciliary ridge of the os frontis, towards the inner canthus, where they intermix with those of the occipito-frontalis and corrugator supercilii; then covering the upper eyelid, they descend to the inner angle opposite to the inferior origin of this muscle, firmly adhering to the internal angular process of the os frontis, and to the short round tendon which serves to fix the palpebræ and muscular fibres arising from it.

Inserted, by the short round tendon, into the nasal process of the superior maxillary bone, covering the anterior and upper part of the lachrymal sac; which tendon can be easily felt at the inner canthus of the eye.

Use. To shut the eye, by drawing both lids close together, the fibres contracting from the outer angle towards the inner, press the eyeball, squeeze the lachrymal gland, and convey the tears towards the puncta lachrymalia.

The *ciliaris* of some authors is only a part of this muscle covering the cartilages of the eyelids, called *cilia* or *tarsi.*

There is often a small fleshy slip, which runs down from the outer and inferior part of this muscle above the zygomaticus minor, and joins with the levator labii superioris alæque nasi.

2. *Levator Palpebræ Superioris,*

Arises from the upper part of the foramen opticum of the sphenoid bone, through which the optic nerve passes, above the levator oculi, near the trochlearis muscle.

Inserted, by a broad thin tendon, into the cartilage that supports the upper eyelid, named *tarsus.*

Use. To open the eye, by drawing the eyelids upwards; which it does completely, by being fixed to the tarsus, pulling it below the eyebrow, and within the orbit.

Muscles of the Eyeball.

The muscles which move the globe of the eye are six, viz. Four *straight*, and two *oblique.*

The four straight muscles very much resemble each other: all

Arising by a narrow beginning, a little tendinous and fleshy, from the bottom of the orbit around the foramen opticum of the sphenoid bone, where the optic nerve enters, so that they may be taken out adhering to this nerve; and all having strong fleshy bellies.

Inserted at the forepart of the globe of the eye into the anterior part of the tunica sclerotica, and under the tunica adnata, at opposite sides, which indicates both their names and *Use;* so that they scarcely require any further description than to name them singly.

1. *Levator Oculi,*

Arises from the upper part of the foramen opticum of the sphenoid bone, below the levator palpebræ superioris, and runs forwards to be

Inserted into the superior and forepart of the tunica sclerotica, by a broad thin tendon.

Use. To raise up the globe of the eye.

2. *Depressor Oculi,*

Arises from the inferior part of the foramen opticum.

Inserted opposite to the former.

Use. To pull the globe of the eye down.

3. *Adductor Oculi,*

Arises, as the former, between the obliquus superior and depressor, being, from its situation, the shortest.

Inserted opposite to the inner angle.

Use. To turn the eye towards the nose.

4. *Abductor Oculi,*

Arises from the bony partition between the foramen opticum and lacerum, being the longest from its situation; and is

Inserted into the globe opposite to the outer canthus.

Use. To move the globe outwards.

The oblique muscles are two:

Obliquus Superior, seu *Trochlearis,*

Arises, like the straight muscles, from the edge of the foramen opticum at the bottom of the orbit, between the levator and adductor oculi; from thence, runs straight along the pars plana of the ethmoid bone to the upper part of the orbit, where a cartilaginous trochlea is fixed to the inside of the internal

angular process of the os frontis, through which its tendon passes, and runs a little downwards and outwards, enclosed in a loose membranous sheath.

Inserted, by a broad thin tendon, into the tunica sclerotica, about half way between the insertion of the attollens oculi and optic nerve.

Use. To roll the globe of the eye, and turn the pupil downwards and outwards, so that the upper side of the globe is turned inwards, and the inferior part to the outside of the orbit, and the whole globe drawn forwards towards their inner canthus.

2. *Obliquus Inferior*,

Arises, by a narrow beginning, from the outer edge of the orbitar process of the superior maxillary bone, near its juncture with the os unguis; and running obliquely outwards, is

Inserted into the sclerotica, in the space between the abductor and optic nerve, by a broad thin tendon.

Use. To draw the globe of the eye forwards, inwards, and downwards; and, contrary to the superior, to turn the pupil upwards towards the inner extremity of the eyebrow; at the same time, the external part of the globe is turned towards the inferior side, and the internal rolls towards the upper part.

The Muscle of the Nose.

There is only one muscle on each side that can be called proper to the nose, though it is affected by several muscles of the face.

Compressor Naris,

Arises by a narrow beginning, from the root of the ala nasi externally, where part of the levator labii superioris alæque nasi is connected to it; it spreads

into a number of thin separate fibres, which run up along the cartilage in an oblique manner towards the dorsum of the nose, where it joins with its fellow, and is

Inserted slightly into the anterior extremity of the os nasi and nasal process of the superior maxillary bone, where it meets with some of the fibres descending from the occipito-frontalis muscle.

Use. To compress the ala towards the septum nasi, particularly when we want to smell acutely; but, if the fibres of the frontal muscle, which adhere to it, act, the upper part of this thin muscle assists to pull the ala outwards. It also corrugates the skin of the nose, and assists in expressing certain passions.

Muscles of the Mouth and Lips.

The mouth has nine pair of muscles, which are inserted into the lips, and a common one formed by the termination of these, viz. three *above*, three *below*, three *outwards*, and the common muscle surrounds the mouth.

The three above are,

1. *Levator Anguli Oris,*

Arises, thin and fleshy, from the hollow of the superior maxillary bone, between the root of the socket of the first dens molaris and the foramen infra orbitarium.

Inserted into the angle of the mouth and under lip, where it joins with its antagonist.

Use. To draw the corner of the mouth upwards, and make that part of the cheek opposite to the chin prominent, as in smiling.

2. *Levator Labii Superioris Alæque Nasi,*

Arises by two distinct origins: the first broad and fleshy, from the external part of the orbitar process

of the superior maxillary bone which forms the lower part of the orbit, immediately above the foramen infra-orbitarium; the second portion arises from the nasal process of the superior maxillary bone, where it joins the os frontis at the inner canthus, descending along the edge of the groove for the lachrymal sac. The first and shortest portion is

Inserted into the upper lip and orbicularis labiorum; the second and longest, into the upper lip and outer part of the ala nasi.

Use. To raise the upper lip towards the orbit, and a little outwards; the second portion serves to draw the skin of the nose upwards and outwards, by which the nostril is dilated.

3. *Depressor Labii Superioris Alæque Nasi,*

Arises, thin and fleshy, from the os maxillare superius, immediately above the joining of the gums with the two dentes incisores and the dens caninus; from thence it runs up under part of the levator labii superioris alæque nasi.

Inserted into the upper lip and root of the ala nasi.

Use. To draw the upper lip and ala nasi downwards and backwards.

The three below are,

1. *Depressor Anguli Oris,*

Arises, broad and fleshy, from the lower edge of the maxilla inferior, at the side of the chin, being firmly connected to that part of the platysma myoides, which runs over the maxilla to the angle of the mouth, to the depressor labii inferioris within, and to the skin and fat without, gradually turning narrower; and is

Inserted into the angle of the mouth, joining with the zygomaticus major and levator anguli oris.

Use. To pull down the corner of the mouth.

2. *Depressor Labii Inferioris,*

Arises, broad and fleshy, intermixed with fat, from the inferior part of the lower jaw next to the chin; runs obliquely upwards, and is

Inserted into the edge of the under lip, extends along one half of the lip, and is lost in its red part.

Use. To pull the under lip and the skin of the side of the chin downwards, and a little outwards.

3. *Levator Labii Inferioris,*

Arises, from the lower jaw, at the roots of the alveoli of two dentes incisores and of the caninus; is

Inserted into the under lip and skin of the chin.

Use. To pull the parts into which it is inserted upwards.

The three outward are,

1. *Buccinator,*

Arises, tendinous and fleshy, from the lower jaw, as far back as the last dens molaris and forepart of the root of the coronoid process; fleshy from the upper jaw, between the last dens molaris and pterygoid process of the sphenoid bone; from the extremity of which it arises tendinous, being continued between both jaws to the constrictor pharyngis superior, with which it joins; from thence proceeding with straight fibres, and adhering close to the membrane that lines the mouth, it is

Inserted into the angle of the mouth within the orbicularis oris.

Use. To draw the angle of the mouth backwards and outwards, and contract its cavity, by pressing the cheek inwards, by which the food is thrust between the teeth.

2. *Zygomaticus Major.*

Arises, fleshy, from the os malæ, near the zygomatic suture.

Inserted into the angle of the mouth, appearing to be lost in the depressor anguli oris and orbicularis oris.

Use. To draw the corner of the mouth and under lip towards the origin of the muscle, and make the cheek prominent, as in laughing.

3. *Zygomaticus Minor.*

Arises from the upper prominent part of the os malæ, above the origin of the former muscle; and, descending obliquely downwards and forwards, is

Inserted into the upper lip, near the corner of the mouth, along with the levator anguli oris.

Use. To draw the corner of the mouth obliquely outwards, and upwards, towards the external canthus of the eye.

The common muscle is the

Orbicularis Oris.

This muscle is, in a great measure, formed by the muscles that move the lips; the fibres of the superior descending, those of the inferior ascending, and, decussating each other about the corner of the mouth, run along the lip to join those of the opposite side, so that the fleshy fibres appear to surround the mouth like a sphincter.

Use. To shut the mouth, by contracting and drawing both lips together, and to counteract all the muscles that assist in forming it.

There is another small muscle described by Albinus, which he calls *Nasalis labii superioris;* but it seems to be only some fibres of the former connected to the septum nasi.

Muscles of the Lower Jaw.

The lower jaw has four pair of muscles for its elevation or lateral motions, viz. two, which are seen on the side of the face, and two concealed by the angle of the jaw.

1. *Temporalis,*

Arises, fleshy, from a semicircular ridge of the lower and lateral part of the parietal bone, from all the pars squamosa of the temporal bone, from the external angular process of the os frontis, from the temporal process of the sphenoid bone, and from an aponeurosis which covers it; from these different origins the fibres descend like radii towards the jugum, under which they pass; and are

Inserted, by a strong tendon, into the upper part of the coronoid process of the lower jaw; in the duplicature of which tendon this process is enclosed as in a sheath, being continued down all its forepart to near the last dens molaris.

Use. To pull the lower jaw upwards, and press it against the upper, at the same time drawing it a little backwards.

N. B. This muscle is covered with a tendinous membrane, called its *aponeurosis*, which arises from the bones that give origin to the upper and semicircular part of the muscle; and, descending over it, is inserted into all the jugum, and the adjoining part of the os frontis.

The use of this membrane is to give room for the origin of a greater number of fleshy fibres, to fortify the muscle in its action, and to serve as a defence to it.

2. *Masseter,*

Arises, by strong, tendinous, and fleshy fibres,

which run in different directions, from the superior maxillary bone, where it joins the os malæ, and from the inferior and anterior part of the zygoma, *its whole length*, the external fibres slanting backwards, and the internal forwards,

Inserted into the angle of the lower jaw, and from that upwards to near the top of its coronoid process.

Use. To pull the lower to the upper jaw, and by means of its oblique decussation, a little forwards and backwards.

3. *Pterygoideus Internus,*

Arises, tendinous and fleshy, from the inner and upper part of the internal plate of the pterygoid process, filling all the space between the two plates; and from the pterygoid process of the os palati between these plates.

Inserted into the angle of the lower jaw internally.

Use. To draw the jaw upwards; and obliquely towards the opposite side.

4. *Pterygoideus Externus,*

Arises from the outer side of the external plate of the pterygoid process of the sphenoid bone, from part of the tuberosity of the os maxillare adjoining to it, and from the root of the temporal process of the sphenoid bone.

Inserted into a cavity in the neck of the condyloid process of the lower jaw; some of its fibres are inserted into the ligament that connects the moveable cartilage and that process to each other.

Use. To pull the lower jaw forwards, and to the opposite side; and to pull the ligament from the joint, that it may not be pinched during these motions: when both external pterygoid muscles act, the fore teeth of the under jaw are pushed forwards beyond those of the upper jaw.

The Muscles which appear about the anterior part of the Neck.

On the side of the neck are two muscles, or layers,

1. *Musculus Cutaneus*, vulgo *Platysma Myoides*,

Arises, by a number of slender separate fleshy fibres, from the cellular substance that covers the upper parts of the deltoid and pectoral muscles; in their ascent they all unite to form a thin muscle, which runs obliquely upwards along the side of the neck, adhering to the skin.

Inserted into the lower jaw, between its angle and the origin of the depressor anguli oris, to which it is firmly connected, and but slightly to the skin that covers the inferior part of the masseter muscle and parotid glands.

Use. To assist the depressor anguli oris, in drawing the skin of the cheek downwards; and when the mouth is shut, it draws all that part of the skin, to which it is connected, below the lower jaw, upwards.

2. *Sterno-cleido-Mastoideus*,

Arises by two distinct origins: the anterior, tendinous and a little fleshy, from the top of the sternum near its junction with the clavicle; the posterior, fleshy, from the upper and anterior part of the clavicle; both unite a little above the anterior articulation of the clavicle, to form one muscle, which runs obliquely upwards and outwards, to be

Inserted, by a thick strong tendon, into the mastoid process, which it surrounds; and, gradually turning thinner, is inserted as far back as the lambdoid suture.

Use. To turn the head to one side, and bend it forwards.

Muscles situated between the Lower Jaw and Os Hyoides.

There are four layers before, and two muscles at the side.

The four layers are,

1. *Digastricus,*

Arises, by a fleshy belly, intermixed with tendinous fibres, from the fossa at the root of the mastoid process of the temporal bone, and soon becomes tendinous; runs downwards and forwards: the tendon passes generally through the stylo-hyoideus muscle; then it is fixed by a ligament to the os hyoides; and, having received from that bone an addition of tendinous and muscular fibres, runs obliquely forwards, turns fleshy again, and is.

Inserted, by its anterior belly, into a rough sinuosity at the inferior and anterior edge of that part of the lower jaw called the *chin.*

Use. To open the mouth, by pulling the lower jaw downwards, and backwards; and when the jaws are shut, to raise the os hyoides, and consequently the pharynx, upwards, as in deglutition.

2. *Mylo-Hyoideus,*

Arises, fleshy, from all the inside of the lower jaw, between the last dens molaris and the middle of the chin, where it joins with its fellow.

Inserted into the lower edge of the basis of the os hyoides, and joins with its fellow.

Use. To pull the os hyoides forwards, upwards, and to a side.

3. *Genio-Hyoideus,*

Arises, tendinous, from a rough protuberance in the middle of the lower jaw internally, or on the inside of the chin.

Inserted into the basis of the os hyoides.

Use. To draw this bone forwards to the chin.

4. *Genio-Hyo-Glossus,*

Arises, tendinous, from a rough protuberance in the inside of the middle of the lower jaw: its fibres run, like a fan, forwards, upwards, and backwards; and are

Inserted into the whole length of the tongue, and base of the os hyoides, near its cornu.

Use. According to the direction of its fibres, to draw the tip of the tongue backwards into the mouth, the middle downwards, and to render its dorsum concave; to draw its root and os hyoides forwards, and to thrust the tongue out of the mouth.

The two muscles at the side are,

1. *Hyo-Glossus,*

Arises, broad and fleshy, from the base, cornu, and appendix of the os hyoides; the fibres run upwards and outwards, to be

Inserted into the side of the tongue, near the stylo-glossus.

Use. To pull the tongue inwards and downwards.

2. *Lingualis,*

Arises from the root of the tongue laterally; runs forwards between the hyo-glossus and genio-glossus, to be

Inserted into the tip of the tongue, along with part of the stylo-glossus.

Use. To contract the substance of the tongue, and bring it backwards, and to elevate the point of the tongue.

Muscles situated between the Os Hyoides and Trunk.

These may be divided into two layers.

The first layer consists of two muscles.

1. *Sterno-Hyoideus,*

Arises, thin and fleshy, from the cartilaginous extremity of the first rib, the upper and inner part of the sternum, and from the clavicle where it joins with the sternum.

Inserted into the base of the os hyoides.

Use. To pull the os hyoides downwards.

2. *Omo-Hyoideus,*

Arises, broad, thin, and fleshy, from the superior costa of the scapula, near the semilunar notch, and from the ligament that runs across it; thence ascending obliquely, it becomes tendinous below the sterno-cleido-mastoid muscle; and, growing fleshy again, is

Inserted into the base of the os-hyoides, between its cornu and the insertion of the sterno-hyoideus.

Use. To pull the os hyoides obliquely downwards.

The second layer consists of three muscles:

1. *Sterno-Thyroideus,*

Arises, fleshy, from the whole edge of the uppermost bone of the sternum internally, opposite to the cartilage of the first rib, from which it receives a small part of its origin.

Inserted into the surface of the rough line at the external part of the inferior edge of the thyroid cartilage.

Use. To draw the larynx downwards.

2. *Thyro-Hyoideus,*

Arises from the rough line, opposite to the former.

Inserted into part of the basis, and almost all the cornu of the os hyoides.

Use. To pull the os hyoides downwards, or the thyroid cartilage upwards.

3. *Crico Thyroideus.*

Arises from the side and forepart of the cricoid cartilage, running obliquely upwards.

Inserted by two portions: the first, into the lower part of the thyroid cartilage; the second, into its inferior cornu.

Use. To pull forwards and depress the thyroid, or to elevate and draw backwards the cricoid cartilage.

Muscles situated between the Lower Jaw and Os Hyoides laterally.

They are five in number. They proceed from the styloid process of the temporal bone, from which they have half of their names; and two from the pterygoid process of the sphenoid bone.

The three from the styloid process are,

1. *Stylo-Glossus,*

Arises, tendinous and fleshy, from the styloid process, and from a ligament that connects that process to the angle of the lower jaw.

Inserted into the root of the tongue, runs along its side, and is insensibly lost near its apex.

Use. To draw the tongue laterally and backwards.

2. *Stylo-Hyoideus,*

Arises, by a round tendon, from the middle and inferior part of the styloid process.

Inserted into the os hyoides at the junction of the base and cornu.

Use. To pull the os hyoides to one side, and a little upwards.

N. B. Its fleshy belly is generally perforated by the tendon of the digastric muscle, on one or both sides. There is often another accompanying it, called

stylo-hyoideus alter; and has the same origin, insertion and use.

3. *Stylo-Pharyngeus,*

Arises, fleshy, from the root of the styloid process.

Inserted into the side of the pharynx and back part of the thyroid cartilage.

Use. To dilate and raise the pharynx and thyroid cartilage upwards.

The two from the pterygoid process are,

1. *Circumflexus,* or *Tensor Palati,*

Arises from the spinous process of the sphenoid bone, behind the foramen ovale, which transmits the third branch of the fifth pair of nerves; from the eustachian tube, not far from its osseous part; it then runs down along the pterygoideus internus, passes over the hook of the internal plate of the pterygoid process by a round tendon, which soon spreads into a broad membrane.

Inserted into the velum pendulum palati, and the semilunar edge of the os palati, and extends as far as the suture which joins the two bones. Generally some of its posterior fibres join with the constrictor pharyngis superior, and palato-pharyngeus.

Use. To stretch the velum, to draw it downwards, and to a side towards the hook. It has little effect upon the tube, being chiefly connected to its osseous part.

2. *Levator Palati,*

Arises, tendinous and fleshy, from the extremity of the pars petrosa of the temporal bone, where it is perforated by the eustachian tube, and also from the membranous part of the same tube.

Inserted into the whole length of the velum pen-

dulum palati, as far as the root of the uvula, and unites with its fellow.

Use. To draw the velum upwards and backwards, so as to shut the passage from the fauces into the mouth and nose.

Muscles situated about the passage of the Fauces.

There are two on each side, and a single one in the middle.

The two on each side, are,

1. *Constrictor Isthmi Faucium,*

Arises, by a slender beginning, from the side of the tongue, near its root; thence running upwards within the anterior arch, before the amygdala; it is,

Inserted into the middle of the velum pendulum palati, at the root of the uvula anteriorly, being connected with its fellow, and with the beginning of the palato-pharyngeus.

Use. Draws the velum toward the root of the tongue, which it raises at the same time, and, with its fellow, contracts the passage between the two arches, by which it shuts the opening into the fauces.

2. *Palato Pharyngeus.*

Arises, by a broad beginning, from the middle of the velum pendulum palati, at the root of the uvula posteriorly, and from the tendinous expansion of the circumflexus palati. The fibres are collected within the posterior arch behind the amygdalæ, and run backwards to the top and lateral part of the pharynx, where the fibres are scattered, and mix with those of the stylo-pharyngeus.

Inserted into the edge of the upper and back part of the thyroid cartilage; some of the fibres being lost

between the membrane of the pharynx, and the two inferior constrictors.

Use. Draws the uvula and velum downwards and backwards; and at the same time pulls the thyroid cartilage and pharynx upwards, and shortens it; with the constrictor superior and tongue, it assists in shutting the passage into the nostrils; and, in swallowing, it thrusts the food from the fauces into the pharynx.

Salpingo Pharyngeus,

Of Albinus, is composed of a few fibres of this muscle, which

Arise from the anterior and lower part of the cartilaginous extremity of the eustachian tube; and are,

Inserted into the inner part of the last-mentioned muscle.

Use. To assist the former, and to dilate the mouth of the tube.

The one in the middle is the

Azygos Uvulæ,

Arises, fleshy, from the extremity of the suture which joins the palate-bones, runs down the whole length of the velum and uvula, resembling a small earth-worm, and adhering to the tendons of the circumflexi.

Inserted into the apex of the uvula.

Use. Raises the uvula upwards and forwards, and shortens it.

Muscles situated on the posterior part of the Pharynx.

Of these there are three pair.

1. *Constrictor Pharyngis Inferior,*

Arises from the side of the thyroid cartilage, near the attachment of the thyroideus and thyreo-hyoideus

muscles; and from the cricoid cartilage, near the crico thyroideus. This muscle is the largest of the three; and is

Inserted into the white line, where it joins with its fellow; the superior fibres running obliquely upwards, covering nearly one half of the middle constrictor, and terminating in a point; the inferior fibres run more transversely, and cover the beginning of the œsophagus.

Use. To compress that part of the pharynx which it covers, and to raise it with the larynx a little upwards.

2. *Constrictor Pharyngis Medius,*

Arises from the appendix of the os hyoides, from the cornu of that bone, and from the ligament which connects it to the thyroid cartilage; the fibres of the superior part running obliquely upwards, and, covering a considerable part of the superior constrictor, terminate in a point.

Inserted into the middle of the cuneiform process of the os occipitis, before the foramen magnum, and joined to its fellow at a white line in the middle back part of the pharynx. The fibres at the middle part run more transversely than those above or below.

Use. To compress that part of the pharynx which it covers, and to draw it and the os hyoides upwards.

3. *Constrictor Pharyngis Superior,*

Arises, above, from the cuneiform process of the os occipitis, before the foramen magnum, near the holes where the ninth pair of nerves passes out; lower down, from the pterygoid process of the sphenoid bone; from the upper and under jaw, near the roots of the last dentes molares; and between the jaws, it is continued with the buccinator muscle; and

with some fibres from the root of the tongue, and from the palate.

Inserted into a white line in the middle of the pharynx, where it joins with its fellow, and is covered by the constrictor medius.

Use. To compress the upper part of the pharynx, and draw it forwards and upwards.

Muscles situated about the Glottis.

They consist generally of four pair of small muscles, and a single one.

1. *Crico-Arytænoideus Posticus,*

Arises, fleshy, from the back part of the cricoid cartilage, and is

Inserted into the posterior part of the base of the arytenoid cartilage.

Use. To open the rima glottidis a little, and, by pulling back the arytenoid cartilage, to stretch the ligament so as to make it tense.

2. *Crico-Arytænoideus Lateralis,*

Arises, fleshy, from the cricoid cartilage, laterally, where it is covered by part of the thyroid, and is

Inserted into the side of the base of the arytenoid cartilage near the former.

Use. To open the rima glottidis, by pulling the ligaments from each other.

3. *Thyreo-Arytænoideus,*

Arises from the under and back part of the middle of the thyroid cartilage; and, running backwards and a little upwards, along the side of the glottis, is

Inserted into the arytenoid cartilage, higher up and farther forwards than the crico-arytænoides lateralis.

Use. To pull the arytenoid cartilage forwards

nearer to the middle of the thyroid, and consequently to shorten and relax the ligament of the larynx or glottis vera.

4. *Arytænoideus Obliquus.*

Arises from the base of one arytenoid cartilage; and, crossing its fellow, is

Inserted near the tip of the other arytenoid cartilage.

Use. When both act, they pull the arytenoid cartilages towards each other.

N. B. One of these is very often wanting.

The single muscle is, the

Arytænoideus Transversus,

Arises from the side of one arytenoid cartilage, from near its articulation with the cricoid to near its tip. The fibres run straight across, and are

Inserted, in the same manner, into the other arytenoid cartilage.

Use. To shut the rima glottidis, by bringing these two cartilages, with the ligaments, nearer one another.

Besides these, there are a few separate muscular fibres on each side: which, from their general direction, are named,

1. *Thyreo-Epiglottideus,*

Arises, by a few pale separated fibres, from the thyroid cartilage; and is

Inserted into the epiglottis laterally.

Use. To draw the epiglottis obliquely downwards, or, when both act, directly downwards; and at the same time, it expands that soft cartilage.

2. *Artyæno-Epiglottideus,*

Arises, by a number of small fibres, from the la-

teral and upper part of the arytenoid cartilage; and, running along the outer side of the external rima, is

Inserted into the epiglottis along with the former.

Use. To pull that side of the epiglottis towards the external rima; or, when both act, to pull it close upon the glottis. It is counteracted by the elasticity of the epiglottis.

Muscles situated on the Anterior Part of the Neck, close to the Vertebræ.

These consist of one layer, formed by four muscles.

1. *Longus Colli,*

Arises, tendinous and fleshy, from the bodies of the three vertebræ of the back laterally; and from the transverse process of the third, fourth, fifth and sixth vertebræ of the neck, near their roots.

Inserted into the forepart of the bodies of all the vertebræ of the neck, by as many small tendons, which are covered with flesh.

Use. To bend the neck gradually forwards, and to one side.

2. *Rectus Capitis Internus Major.*

Arises, from the anterior points of the transverse processes of the third, fourth, fifth and sixth vertebræ of the neck, by four distinct beginnings.

Inserted into the cuneiform process of the os occipitis, a little before the condyloid process.

Use. To bend the head forwards.

3. *Rectus Capitis Internus Minor,*

Arises fleshy, from the forepart of the body of the first vertebra of the neck, opposite to the superior oblique process.

Inserted near the root of the condyloid process of the os occipitis, under, and a little farther outwards, than the former muscle.

Use. To bend the head forwards.

4. *Rectus Capitis Lateralis,*

Arises, fleshy, from the anterior part of the point of the transverse process of the first vertebra of the neck.

Inserted into the os occipitis, opposite to the foramen stylo-mastoideum of the temporal bone.

Use. To bend the head a little to one side.

Muscles situated on the Anterior Part of the Thorax.

These may be divided into two layers. The first layer consists of one muscle, named

Pectoralis Major,

Arises from the cartilaginous extremities of the fifth and sixth ribs, where it always intermixes with the external oblique muscle of the abdomen; from almost the whole length of the sternum; and from near half of the anterior part of the clavicle: the fibres run towards the axilla in a folding manner.

Inserted, by two broad tendons, which cross each other at the upper and inner part of the os humeri, above the insertion of the deltoid muscle, and outer side of the groove for lodging the tendon of the long head of the biceps.

Use. To move the arm forwards, and obliquely upwards, towards the sternum.

The second layer consists of three muscles.

1. *Subclavius,*

Arises, tendinous, from the cartilage that joins the first rib to the sternum.

Inserted, after becoming fleshy, into the inferior part of the clavicle, which it occupies from within an inch of the sternum, as far outwards as to its con-

nexion, by ligament, with the coracoid process of the scapula.

Use. To pull the clavicle downwards and forwards.

2. *Pectoralis Minor,*

Arises, tendinous and fleshy, from the upper edge of the third, fourth, and fifth ribs, near where they join with their cartilages.

Inserted, tendinous, into the coracoid process of the scapula; but soon grows fleshy and broad.

Use. To bring the scapula forwards and downwards, or to raise the ribs upwards.

3. *Serratus Magnus,*

Arises from the nine superior ribs, by an equal number of fleshy digitations, resembling the teeth of a saw.

Inserted, fleshy, into the whole base of the scapula internally, between the insertion of the rhomboid and the origin of the subscapularis muscle, being folded about the two angles of the scapula.

Use. To move the scapula forwards; and, when the scapula is forcibly raised, to draw upwards the ribs.

Muscles situated between the Ribs, and within the Thorax.

Between the ribs, on each side, there are eleven double rows of muscles, which are therefore named *intercostals.* These decussate each other like the strokes of the letter X.

1. *Intercostales Externi,*

Arise, from the inferior acute edge of each superior rib, and run obliquely forwards, the whole length from the spine to near the joining of the ribs with

their cartilages: from which, to the sternum, there is only a thin membrane covering the internal intercostals.

Inserted into the upper obtuse edge of each inferior rib, as far back as the spine, into which the posterior portion is fixed.

2. *Intercostales Interni.*

Arise in the same manner as the external: but they begin at the sternum, and run obliquely backwards, as far as the angle of the rib; and from that to the spine they are wanting.

Inserted in the same manner as the external.

Use. By means of these muscles, the ribs are equally raised upwards, during inspiration. Their fibres being oblique, give them a greater power of bringing the ribs near each other, than could be performed by straight ones. But, by the obliquity of the fibres, they are almost brought contiguous: and as the fixed points of the ribs are before and behind, if the external had been continued forwards to the sternum, and the internal backwards to the spine, it would have hindered their motion, which is greatest in the middle, though the obliquity of the ribs renders it less perceptible; and, instead of raising the fibres fixed to the sternum and spine, would have depressed the ribs.

N. B. The portions of the external intercostals, which arise from the transverse processes of the vertebræ where the ribs are fixed to them, and other portions that pass over one rib and terminate in the next below it, Albinus calls *Levatores costarum longiores et breviores.*

The portions of the internal that pass over one rib, and are inserted into the next below it, are by Douglas called, *Costarum depressores proprii Cowperi.*

These portions of both rows assist in raising the

ribs in the same manner as the rest of the intercostals.

The muscles within the thorax are one pair, viz.

Triangularis, or Sterno-costalis,

Arises, fleshy, and a little tendinous, from all the length of the cartilago ensiformis laterally, and from the edge to the lower half of the middle bone of the sternum, from whence its fibres ascend obliquely upwards and outwards.

Inserted, generally by three triangular terminations, into the lower edge of the cartilages of the third, fourth, and fifth ribs; near where these join with the ribs.

Use. To depress these cartilages, and the extremities of the ribs; and consequently to assist in contracting the cavity of the thorax.

This muscle often varies; and is sometimes inserted into the cartilage of the second rib, sometimes into the cartilages of the sixth rib.

Muscles situated on the anterior part of the Abdomen.

They consist of three broad layers on each side of the belly; and of one layer in front.

The three layers are:

1. *Obliquus Descendens Externus,*

Arises, by eight heads, from the lower edges of an equal number of inferior ribs, at a little distance from their cartilages: it always intermixes, in a serrated manner, with portions of the serratus major anticus; and generally coheres to the pectoralis major, intercostals, and latissimus dorsi; which last covers the edge of a portion of it extended from the last rib to the spine of the ilium.

From these origins the fibres run obliquely down-

wards and forwards, and terminate in the anterior half of the spine of the ilium, and in a tendinous membrane, whose fibres are continued in the same direction until they meet the fibres of the corresponding tendon of the other side, in a line which extends from the ensiform cartilage to the os pubis.

This line is called linea alba, from its white appearance, which is owing to the connexion of three tendons with each other, without the intervention of muscle, viz. those of the external and internal oblique, and the transversalis.

On each side of this line, two long narrow muscles are situated between these tendons, and do away the white appearance; but exterior to these muscles, the tendons are again united, and form a white line on each side, which is called linea semilunaris, from its curved shape.

At the lower part of the tendon, near the os pubis the fibres are so arranged, that they form two bands more firm and dense than the rest of the tendon, which are called columns: these columns are separated from each other; and the vacuity between them is the abdominal ring, or aperture, for the passage of the spermatic chord in males and the round ligament of the uterus in females. This vacuity or aperture has an oval form, which is occasioned by some additional tendinous fibres at the upper part of it, that have a transverse direction.

The uppermost of the two columns is continued obliquely downwards, and is inserted into the os pubis of the opposite side, near the symphysis, decussating the fibres of the corresponding column of that side.

The lower edge of the tendon of the external oblique is attached to the superior anterior spinous process of the ilium, and is there blended with the tendinous fascia, which extends down the thigh.

From this process the edge of the tendon is extended, like the chord of a bow, across the concavity formed by the os ilium and os pubis, and is inserted into the pubis near its symphysis. As it proceeds from the spine of the ilium towards the pubis, the edge is folded inwards, so that the membrane is doubled. The portion which is turned inwards is very small at its commencement, and continues so for a great part of its extent; but becomes much broader within an inch of its termination. This broad extremity is inserted into the small process of the pubis near the symphysis, and into a ridge which continues backward from the process to the brim of the pelvis, so that the tendinous membrane at this part is doubled; the part which is turned back being about an inch broad at the place of its insertion into the pubis.

This doubling forms a partial sheath near the pubis for containing the spermatic chord, and supports it for a short distance on the inside of the abdominal ring.

The edge formed by the fold of the membrane is called *Poupart's* ligament; and is very firm and strong; owing to the membrane being thicker at that place. The real edge, or termination of the portion which is folded inwards, is arranged in the following manner: The part which is nearest to the spine of the ilium is continued into the cellular membrane, or the fascia, which is between the internal oblique and transversalis muscles, and the iliacus internus.

But the edge of that part which is inserted into the ridge of the pubis seems to form a portion of a circular opening, which is occupied in part, but not completely, by the crural vessels.

A portion of the fascia of the thigh, which covers these vessels, passes under this portion of the tendon, and is also inserted into the ridge of the pubis; so

that when the intestines protrude at this aperture, and are strangulated, this portion of the fascia of the thigh must also compress them.

The fascia of the thigh is connected with the external edge, or Poupart's ligament, its whole extent: and there is also a fascia which covers the whole tendon of the external oblique muscle, and passes from it down upon the fascia of the thigh: which also connects the tendon of the external oblique to the fascia of the thigh, and serves to bind it down. From these connexions it is probable that the tendon is in a very different situation before dissection, from what it is afterwards; as the division of these connexions, necessarily made by the dissection, renders it much more loose than it could have been while the parts were undivided. This structure has laterally been called the crural arch.*

The external oblique muscles compress the abdomen, and therefore contribute to the evacuation of its contents; if the diaphragm is in a passive state they force it upwards, by pressing the abdominal viscera

* The fascia which covers the tendon of the external oblique muscle, and descends upon the thigh, can be examined very easily in anarsacous subjects; as in them, the cellular membrane, which is situated between this fascia and the tendon, is somewhat distended by the effused fluid.

To prepare Poupart's ligament, or the crural arch, for examination, remove carefully the cellular membrane from the tendon of the external oblique, and also from the fascia of the thigh, taking care not to remove any part of the fascia which passes under the tendon to be inserted into the os pubis. Then make an incision in the tendon of the external oblique, about three inches above Poupart's ligament, parallel to it and nearly of the same length; make a second incision from the upper end of this, to the junction of the aforesaid ligament with the superior anterior spine of the ilium; and a third incision from the lower end to the abdominal ring. Dissect this flap carefully from the internal oblique, until the spermatic chord, the cremaster muscle, and the lower origin of the internal oblique, are perfectly uncovered. After examining the internal surface of the tendon, and its insertion at the pubis, the fascia of the thigh may be dissected, so that its connexion with the folded edge of the tendon, and its insertion into the pubis, may also be examined.

against it; and thus assist in producing expiration and its various modifications of coughing, sneezing, &c.

They bend the spine forwards, or approach the thorax to the pelvis.

When one acts separately, it bends the trunk obliquely to the side on which it is situated.

3. *Obliquus Ascendens Internus.*

Arises from the spine of the ilium the whole length between the posterior and superior anterior spinous process; from the os sacrum and the three undermost lumber vertebræ, by a tendon common to it, to the serratus posticus inferior muscle, and to the latissimus dorsi; from Poupart's ligament, at the middle of which it sends off the beginning of the cremaster muscle; and the spermatic chord in the male, or round ligament of the womb in the female, passes under its thin edge, except a few detached fibres.

Inserted into the cartilago ensiforms, into the cartilages of the seventh, and those of the false ribs; but, at the upper part, it is extremely thin, resembling a cellular membrane, and only becomes fleshy at the cartilage of the tenth rib. Here its tendon divides into two layers: the anterior layer, with a great portion of the inferior part of the posterior layer, joins the tendon of the external oblique, and runs over the rectus to be inserted into the whole length of the linea alba. The posterior layer joines the tendon of the transversalis muscle as low as half way between the umbilicus and os pubis; but below this place only a few fibres of the posterior layer are seen, and the rest of it passes before the rectus muscle, and is inserted into the linea alba; so that the whole tendon of the external oblique muscle, with the anterior layer of the internal oblique, passes before the rectus muscle; and the whole posterior layer

of the internal oblique, together with the whole tendon of the transversalis muscle, excepting at the inferior part, passes behind the rectus, and is inserted into the linea alba. At its undermost part, it is inserted into the forepart of the os pubis.

Use. To assist the former; but it bends the trunk in the reverse direction.

3. *Transversalis.*

Arises, tendinous, but soon becoming fleshy, from the inner or back part of the cartilages of the seven lower ribs, where some of its fibres are continued with those of the diaphragm and the intercostal muscles; by a broad thin tendon, connected to the transverse processes of the last vertebra of the back and the four superior vertebræ of the loins: fleshy, from the whole spine of the os ilium internally, and from the tendon of the external oblique muscle where it intermixes with some fibres of the internal oblique.

Inserted into the cartilago ensiformis, and into the whole length of the linea alba, excepting its lowermost part.

Use. To support and compress the abdominal bowels, and it is so particularly well adapted for the latter purpose, that it might be called the *proper constrictor* of the abdomen.

The long muscle in the middle is named,

Rectus Abdominis.

Arises, by two heads, from the ligament of the cartilage which joins the two ossa pubis to each other; runs upwards the whole length of, and parallel to the linea alba, growing broader and thinner as it ascends.

Inserted into the cartilages of the three inferior true ribs, and often intermixes with some fibres of the pectoral muscle.

It is generally divided by three tendinous intersections: the first is at the umbilicus; the second, where it runs over the cartilage of the seventh rib; and the third in the middle between these; and there is commonly a half intersection below the umbilicus. These intersections seldom penetrate through the whole thickness of the muscle: they adhere firmly to the anterior part of the sheath, but very slightly to the posterior layer.*

Use. To compress the forepart, but more particularly the lower part of the belly; to bend the trunk forwards, or to raise the pelvis. By its tendinous intersection, it is enabled to contract at any of the intermediate spaces; and, by its connexion with the tendons of the other muscles, it is prevented from changing place, and from rising into a prominent form when in action.

The short muscle in the middle is named

Pyramidalis.

Arises along with the rectus; and, running upwards within the same sheath, is

Inserted, by an acute termination, near half way between the os pubis and umbilicus, into the linea alba and inner edge of the rectus muscle.

As it is frequently wanting in both sides without any inconvenience, its

Use seems to be, to assist the inferior part of the rectus.

* To obtain an accurate idea of the arrangement of the tendons of the three large pair of abdominal muscles, it will be necessary to raise or separate the external oblique muscle and tendon from the internal oblique and its tendon, as far as the linea semilunaris, and to separate the internal oblique in the same manner from the transversalis; and then to make an incision in the tendon of the external oblique parallel to the linea alba, and about an inch and a half from it, so as to bring the whole of the rectus muscle into view. The structure of the sheath which contains the rectus can then be examined.

Muscles about the Male Organs of Generation.

The *testicles* are said to have a thin muscle common to both, and one proper to each.

The common muscle is called the

Dartos.

This consists of muscular fibres blended with the cellular membrane lining the scrotum; and therefore this portion of skin is capable of being corrugated and relaxed in a greater degree than in other places.

The muscle proper to each testicle is the

Cremaster,

Arises from the internal oblique, where a few fibres of that muscle intermix with the transversalis, near the junction of the os ilium and pubis, over which part it passes, after having pierced the ring of the externus obliquus; and then it descends upon the spermatic chord.

Inserted into the tunica vaginalis of the testicle, upon which it spreads, and is insensibly lost.

Use to suspend and draw up the testicle, and to compress it in the act of coition.*

* Mr. J. Cloquet says, that the scattered fasiculi of this muscle are collected after their distribution on the tunica vaginalis, and run up on the inner side of the chord, to be inserted into the spine of the pubis. He makes the inference from this, that the cremaster is a kind of muscular loop, drawn down by the descent of the testicle. I am satisfied that the muscle, in robust subjects, frequently exists, more or less, after the manner in which he speaks of it; but in the emaciated it is very indistinct, as regards such an insertion. In the cases where I have seen this insertion into the spine of the the pubis, the quantity of muscular fibre has been by no means so great there, as at its origin. This observation of Mr. Cloquet's is ingenious and interesting, but it is well worthy of consideration, that Mr. John Hunter's opinion, in his paper on the descent of the testicle, is opposed to it, and on the following grounds. In the young ram, and in several other animals, the cremaster muscle is formed before the testicle descends from the abdomen into the scrotum, being reflected along the gubernaculum testis upwards towards

The penis has three pair of muscles:

1. *Erector Penis.*

Arises, tendinous and fleshy, from the tuberosity of the os ischium, and runs upwards, embracing the whole crus of the penis.

Inserted into the strong tendinous membrane that covers the corpora cavernosa penis nearly as far up as the union of these bodies.

Use. To compress the crura penis, by which the blood is pushed from it into the forepart of the corpora cavernosa; and the penis is by that means more completely distended. The erectores seem likewise to keep the penis in its proper direction.

2. *Accelerator Urinæ, seu Ejaculator Seminis,*

Arises, fleshy, from the sphincter ani and membranous part of the urethra; and tendinous, from the crus, nearly as far forwards as the beginning of the corpus cavernosum penis: the inferior fibres run more transversely; and the superior descend, in an oblique direction.

Inserted into a line in the middle of the bulb where it joins with its fellow, by which the bulb is completely enclosed.

Use. To drive the urine or semen forwards; and, by grasping the bulb of the urethra, to push the blood towards its corpus cavernosum and the glans, by which they are distended.

3. *Transversus Perinei.*

Arises from the tough fatty membrane that covers the tuberosity of the os ischium; from thence it runs transversely inwards, and is

the loins. Mr. Hunter, could not, it is true, verify the same observation on the human subject, but he is disposed, from analogy, to believe that something of the kind exists. Ed.

Inserted into the accelerator urinæ, and into that part of the sphincter ani which covers the bulb.

Use. To dilate the bulb, and draw the perineum and verge of the anus a little outwards and backwards.

There is often a fourth muscle, named

Transversus Perinei Alter,

Arises behind the former, runs more obliquely forwards, and is

Inserted into that part of the accelerator urinæ which covers the anterior part of the bulb of the urethra.

Use. To assist the former.

In the Medico-Chirurgical Transactions, James Wilson, Esq. F. R. S. gives the following account of two small muscles of the membranous part of the urethra, viz. Each muscle has a tendon which at first is round, but soon becomes flattened as it descends. It is affixed to the back part of the symphysis pubis, about one eighth of an inch above the lower edge of the cartilaginous arch of pubes, and nearly at the same distance, below the attachment of the tendon of the bladder: to which, and to the tendon of the corresponding muscle, it is connected by very loose cellular membrane. The tendon descends at first in contact with, and parallel to its fellow: it soon becomes broader and sends off fleshy fibres, which also increase in breadth, and, when near the upper surface of the membranous part of the urethra, separate from those of the opposite side; spread themselves on the side of the membranous part of the urethra through its whole extent; then fold themselves under it, and meet in a middle tendinous line with similar fibres of the opposite side.

Its action seems to be to draw up the membranous part of the urethra, and compress it against the inside of the cartilaginous arch of the pubes; and also to contract the circle round

the membranous portion; so as to diminish and even close up the passage for the urine.*

Muscles of the Anus.

The *anus* has a single muscle, and one pair.

The single muscle is

Sphincter Ani.

Arises from the skin and fat that surrounds the verge of the anus on both sides, nearly as far out as the tuber of the os ischium; the fibres are gradually collected into an oval form, and surround the extremity of the rectum.

Inserted, before, by a narrow point, into the perineum, acceleratores urinæ, and transversi perinei; behind, by an acute termination, into the extremity of the os coccygis.

Use. Shuts the passage through the anus into the rectum; pulls down the bulb of the urethra, by which it assists in ejecting the urine and semen.

N. B. The sphincter internus of Albinus and Douglas is only that part of the circular fibres of the muscular coat of the rectum, which surrounds its extremity.

Levator Ani,

Arises from the os pubis within the pelvis, as far up as the upper edge of the foramen thyroideum, and joining of the os pubis with the os ischium; from the thin tendinous membrane that covers the obtu-

* I have frequently dissected for this muscle, and in only two or three cases have been able to satisfy myself of its having an existence distinct from that of the Levator Ani. My friend, Mr. Shaw, who occupies a distinguished rank among the cultivators of Anatomy in London, admits of this muscle, but says there is much difficulty in distinguishing it from the ligament of the urethra, meaning I presume its triangular ligament. Ed.

rator internus and coccygeus muscle; from the spinous process of the os ischium; and its fibres run down like rays from a circumference to a centre.

Inserted into the sphincter ani, acceleratores urinæ, and anterior part of the two last bones of the os coccygis; surrounds the extremity of the rectum, neck of the bladder, prostate gland. and part of the vesiculæ seminales; so that its fibres behind and below the os coccygis joining it with its fellow, they together very much resemble the shape of a funnel.

Use. To draw the rectum upwards after the evacuation of the fæces, and to assist in shutting it; to sustain the contents of the pelvis, and to help in ejecting the semen, urine, and contents of the rectum; and, perhaps, by pressing upon the veins, to contribute greatly to the erection of the penis.

Muscles of the Female Organs of Generation.

The *clitoris* has one pair.

Erector Clitoridis.

Arises from the crus of the os ischium internally, and in its ascent covers the crus of the clitoris as far up as the os pubis.

Inserted into the upper part of the crus and body of the clitoris.

Use. Draws the clitoris downwards and backwards; and may serve to make the body of the clitoris more tense, by squeezing the blood into it from its crus.

The vagina has one pair.

Sphincter Vaginæ.

Arises from the sphincter ani, and from the posterior side of the vagina, near the perineum: from thence it runs up the side of the vagina, near its external orifice, opposite to the nymphæ and covers the corpus cavernosum vaginæ.

Inserted into the crus and body or union of the crura clitoridis.

Use. Contracts the mouth of the vagina, and compresses its corpus cavernosum.

The perineum has one pair.

Transversus Perinei.

Arises, as in the male, from the fatty cellular membrane which covers the tuberosity of the os ischium.

Inserted into the upper part of the sphincter ani, and into a white hardish tough substance in the perineum, between the lower part of the pudendum and anus.

Use. To sustain and keep the perineum in its proper place.

The anus, as in the male; has a single muscle, and one pair.

Sphincter Ani.

Arises, as in the male, from the skin and fat surrounding the extremity of the rectum.

Inserted, above, into the white tough substance of the perineum; and below, into the point of the os coccygis.

Use. To shut the passage into the rectum; and, by pulling down the perineum, to assist in contracting the mouth of the vagina.

Levator Ani.

Arises, as in the male, within the pelvis, and descends along the inferior part of the vagina and rectum.

Inserted into the perineum, sphincter ani, extremity of the vagina and rectum.

Use. To raise the extremity of the rectum upwards, to contract the inferior part of the rectum,

and to assist in contracting and supporting the vagina; and, perhaps, by pressing on the veins, to contribute to the distention of the cells of the clitoris and corpus cavernosum of the vagina.

Muscles situated within the Cavity of the Abdomen.

These consist of a single muscle, and four pair.

Diaphragma.

This broad thin muscle, which makes a complete septum between the thorax and abdomen, is concave below and convex above; the middle of it on each side reaching as high within the thorax of the skeleton as the fourth rib: it is commonly divided into two portions.

1. The superior, or

Greater Muscle of the Diaphragm.

Arises, by distinct fleshy fibres, from the cartilago ensiformis, from the cartilages of the seventh, and of all the inferior ribs on both sides. The fibres from the cartilago ensiformis, and from the seventh and eighth ribs, run obliquely upwards and backwards; from the ninth and tenth, transversely inwards and upwards; and from the eleventh and twelfth, obliquely upwards. From these different origins the fibres run, like radii from the circumference to the centre of a circle; and are

Inserted into a cordiform tendon, of a considerable breadth, which is situated in the middle of the diaphragm, and in which, therefore, the fibres from opposite sides are interlaced. Towards the right side the tendon is perforated, by a triangular hole, for the passage of the vena cava inferior; and to the upper convex part of it the pericardium and mediastinum are connected.

2. The inferior, lesser muscle, or

Appendix of the Diaphragm.

Arises from the second, third and fourth lumbar vertebræ, by eight heads; of which, two in the middle, commonly called its *crura*, are the longest, and begin tendinous. Between the crura, the aorta and thoracic duct pass; and, on the outside of these, the great sympathetic nerves and branches of the vena azygos perforate the shorter heads. The muscular fibres run obliquely upwards and forwards, and form in the middle two fleshy colums, which decussate and leave an oval space between them for the passage of the œsophagus and eighth pair of nerves.

Inserted, by strong fleshy fibres, into the posterior part of the middle tendon.

Use. The diaphragm is the principal agent in respiration, particularly in inspiration: for when it is in action, the fibres, from their different attachments, endeavour to bring themselves into a plain towards the middle tendon, by which the cavity of the thorax is enlarged, particularly at the sides, where the lungs are chiefly situated; and as the lungs must always be contiguous to the inside of the thorax and upper side of the diaphragm, the air rushes into them, in order to fill up the increased space. This muscle is assisted by the two rows of intercostals, which elevate the ribs, and the cavity of the thorax is more enlarged. In time of violent exercise, or whatever cause drives the blood with unusual celerity towards the lungs, the pectoral muscles, the serrati antici majores, the serrati postici superiores, and scaleni muscles, are brought into action. And in laborious inspiration, the muscles which arise from the upper part of the thorax, when the parts into which they are inserted are fixed, likewise assist. In expiration, the diaphragm is relaxed and pushed up by the

pressure of the abdominal muscles upon the viscera of the abdomen; and at the same time that they press it upwards, they also, together with the sterno-costales and serrati postici inferiores. pull down the ribs, and are assisted in a powerful manner by the elasticity of the cartilages that join the ribs to the sternum; by which the cavity of the thorax is diminished and the air suddenly pushed out of the lungs: and, in laborious expiration, the quadrati lumborum, sacro-lumbales, and longissimi dorsi, concur in pulling down the ribs.

The four pair are,

1. *Quadratus Lumborum,*

Arises, somewhat broad, tendinous and fleshy, from the posterior part of the spine of the os ilium.

Inserted into the transverse processes of all the vertebræ of the loins, into the last rib near the spine, and by a small tendon into the side of the last vertebra of the back.

Use. To move the loins to one side, pull down the last rib, and, when both act, to bend the loins forwards.

2. *Psoas Parvus,*

Arises, fleshy, from the sides of the two upper vertebræ of the loins, and sends off a small long tendon, which ends thin and flat, and is

Inserted into the brim of the pelvis, at the junction of the os ilium and pubis.

Use. To assist the psoas magnus in bending the loins forwards; and, in certain positions, to assist in raising the pelvis.

N. B. This muscle is very often wanting.

3. *Psoas Magnus,*

Arises, fleshy, from the side of the body, and trans-

verse process of the last vertebra of the back; and, in the same manner, from all those of the loins, by as many distinct slips.

Inserted, tendinous, into the trochanter minor of the os femoris; and fleshy into that bone, a little below the same trochanter.

Use. To bend the thigh forwards; or, when the inferior extremity is fixed, to assist in bending the body.

4. *Iliacus Internus*,

Arises, fleshy, from the transverse process of the last vertebra of the loins, from all the inner lip of the spine of the os ilium, from the edge of that bone between its anterior spinous process and the acetabulum, and from most of the hollow part of the ilium. It joins with the psoas magnus, where it begins to become tendinous; and is

Inserted along with it.

Use. To assist the psoas in bending the thigh, and to bring it directly forwards.

N. B. The insertion of the two last muscles should not be prosecuted till the muscles of the thigh are dissected.

Muscles situated within the Pelvis.

Of these there are two pair.

1. *Obturator Internus*,

Arises from more than one half of the internal circumference of the foramen thyroideum, formed by the os pubis and ischium, and from the upper part of the plane of the ischium where it joins the ileum. Its inside is covered by a portion of the levator ani; and appears to be divided into a number of fasciculi, which unite and form a roundish tendon, that passes out of the pelvis. between the posterior sacro ischi-

atic ligament and tuberosity of the os ischium; where it passes over the capsular ligament of the thigh bone, it is enclosed as in a sheath, by the gemini muscles.

Inserted, by a round tendon, into the large pit at the root of the trochanter major.

Use. To roll the os femoris obliquely outwards.

N. B. The insertion of this muscle should not be prosecuted, until the muscles of the thigh, to which it belongs, are dissected.

2. *Coccygeus*,

Arises, tendinous and fleshy, from the spinous process of the os ischium, and covers the inside of the posterior sacro ischiatic ligament: from this narrow beginning, it gradually increases, to form a thin fleshy belly, interspersed with tendinous fibres.

Inserted into the extremity of the os sacrum, and near the whole length of the os coccygis laterally.

Use. To support and move the os coccygis forwards, and to tie it more firmly to the sacrum.

Muscles situated on the Posterior Part of the Trunk.

These may be divided into four layers, and a single pair.

The first layer consists of two muscles, which cover almost the whole posterior part of the trunk.

Trapezius seu *Cucullaris*,

Arises, by a strong round tendon, from the lower part of the protuberance in the middle of the os occipitis behind; and, by a thin membranous tendon, which covers part of the splenius and complexus muscles, from the rough curved line that extends from the protuberance towards the mastoid process of the temporal bone; runs down along the nape of the neck, where it seems to arise from its fellow, and

covers the spinous processes of the superior vertebræ of the neck; but rises from the spinous processes of the two inferior, and from the spinous processes of all the vertebræ of the back: adhering, tendinous, to its fellow, the whole length of its origin.

Inserted, fleshy, into the posterior half of the clavicle; tendinous and fleshy, into the acromion, and into almost all the spine of the scapula.

Use. Moves the scapula according to the three different directions of its fibres: for the upper descending fibres draw it obliquely upwards; the middle transverse straight fibres draw it directly backwards; and the inferior ascending fibres draw it obliquely downwards and backwards.

N. B. Where it is inseparably united to its fellow in the nape of the neck, it is named *Ligamentum Nuchæ or Colli.*

2. *Latissimus Dorsi,*

Arises, by a broad thin tendon, from the posterior part of the spine of the os ilium, from all the spinous processes of the os sacrum and vertebræ of the loins, and from the seven inferior ones of the vertebræ of the back; also tendinous and fleshy, from the extremities of the three or four inferior ribs, a little beyond their cartilages, by as many distinct slips. The inferior fibres ascend obliquely, and the superior run transversely, over the inferior angle of the scapula, towards the axilla, where they are collected, twisted, and folded.

Inserted, by a strong thin tendon, into the inner edge of the groove for lodging the tendon of the long head of the biceps.

Use. To pull the arm backwards and downwards, and to roll the os humeri.

N. B. The insertion of this muscle should not be

prosecuted till the muscles of the os humeri, to which it belongs, are dissected.

The second layer consists of three pair, two on the back, and one on the neck.

On the back:

1. *Serratus Posticus Inferior,*

Arises, by a broad thin tendon, in common with that of the latissimus dorsi, from the spinal processes of the two inferior vertebræ of the back, and from the three superior vertebræ of the loins.

Inserted into the lower edges of the four inferior ribs, at a little distance from their cartilages, by as many distinct fleshy slips.

Use. To depress the ribs into which it is inserted.

2. *Rhomboideus.*

This muscle is divided into two portions.

1. *Rhomboideus major, arises*, tendinous, from the spinous process of the five superior vertebræ of the back.

Inserted into all the basis of the scapula below its spine.

Use. To draw the scapula obliquely upwards, and directly inwards.

2. *Rhomboideus* ~~*major*~~ minor, *arises*, tendinous, from the spinous processes of the three inferior vertebræ of the neck, and from the ligamentum nuchæ.

Inserted into the base of the scapula, opposite to its spine.

Use. To assist the former.

On the neck:

3. *Splenius,*

Arises, tendinous, from the upper superior spinous processes of the vertebræ of the back: tendinous and fleshy, from the five inferior of the neck, and adheres

firmly to the ligamentum nuchæ. At the third vertebra of the neck, the splenii recede from each other, so that part of the complexus muscle is seen.

Inserted, by as many tendons, into the five superior transverse processes of the vertebræ of the neck; and tendinous and fleshy, into the superior part of the mastoid process, and into the os occipitis, where it joins with the root of that process.

Use. To bring the head and upper vertebræ of the neck backwards laterally: and, when both act, to pull the head directly backwards.

N. B. Albinus divides this muscle into two, viz. That portion which arises from the five inferior spinous processes of the neck, and is inserted into the mastoid process and os occipitis, he calls *splenius capitis;* and that portion which arises from the third and fourth of the back, and is inserted into the five superior transverse processes of the neck, is called by him *splenius colli.*

The single pair,

Serratus Superior Posticus,

Arises, by a broad thin tendon, from the spinous processes of the three last vertebræ of the neck, and the two uppermost of the back.

Inserted into the second, third, fourth, and fifth ribs, by as many fleshy slips.

Use. To elevate the ribs, and dilate the thorax.

The third layer consists of three pair on the back, and three on the neck.

Those on the back are,

1. *Spinalis Dorsi,*

Arises, from the spinous processes of the two uppermost vertebræ of the loins, and the three inferior of the back, by as many tendons.

Inserted into the spinous processes of the nine up-

permost vertebræ of the back, except the first, by as many tendons.

Use. To erect and fix the vertebræ, and to assist in raising the spine.

2. *Longissimus Dorsi,*

Arises, tendinous without, and fleshy within, from the side, and all the spinous processes of the os sacrum; from the posterior spine of the os ilium; from all the spinous processes; and from the roots of the transverse processes of the vertebræ of the loins.

Inserted into all the transverse processes of the vertebræ of the back, chiefly by small double tendons; also, by a tendinous and fleshy slip, into the lower edge of all the ribs, except the two inferior, at a little distance from their tubercles.

Use. To extend the vertebræ, and to raise and keep the trunk of the body erect.

N. B. From the upper part of this muscle there runs up a round fleshy portion which joins with the cervicalis descendens.

3. *Sacro-Lumbalis.*

Arises, in common with the longissimus dorsi.

Inserted into all the ribs, where they begin to be curved forwards, by as many long and thin tendons; and,

From the upper part of the six or eight lower ribs, arise as many bundles of thin fleshy fibres, which soon terminate in the inner side of this muscle, and are named *musculi ad sacro-lumbalem accessorii.*

Use. To pull the ribs down, and assist to erect the the trunk of the body.

N. B. There is a fleshy slip which runs from the upper part of this muscle into the fourth, fifth, and sixth transverse processes of the vertebræ of the

neck, by three distinct tendons: it is named *cervicalis descendens;* and *its* use is to turn the neck obliquely backwards, and to one side.

On the neck are,

1. *Complexus.*

Arises from the transverse processes of the seven superior vertebræ of the back, and four inferior of the neck, by as many distinct tendinous origins: in its ascent it receives a fleshy slip from the spinous process of the first vertebra of the back. From these different origins it runs upwards, and is every where intermixed with tendinous fibres.

Inserted, tendinous and fleshy, into the inferior edge of the protuberance in the middle of the os occipitis, and into a part of the curved line that runs forwards from that protuberance.

Use. To draw the head backwards, and to one side; and, when both act, to draw the head directly backwards.

N. B. The long portion of this muscle that is situated next the spinous processes, lies more loose, and has a roundish tendon in the middle of it: for which reason Albinus calls it *biventer cervicis.*

2. *Trachelo-Mastoideus,*

Arises from the transverse processes of the three uppermost vertebræ of the back, and from the five lowermost of the neck, where it is connected to the transversalis cervicis, by as many thin tendons, which unite into a belly, and run up under the splenius.

Inserted into the middle of the posterior side of the mastoid process, by a thin tendon.

Use. To assist the complexus; but it pulls the head more to one side.

3. *Levator Scapulæ.*

Arises, tendinous and fleshy, from the transverse processes of the five superior vertebræ of the neck, by as many distinct slips, which soon unite to form a muscle that runs downwards and outwards.

Inserted, fleshy, into the superior angle of the scapula.

Use. To pull the scapula upwards and a little forwards.

The fourth layer consists of two pair on the back, two on the posterior part of the neck, four small pair situated immediately below the posterior part of the occiput, and three on the side of the neck.

On the back are,

1. *Semi-Spinalis Dorsi.*

Arises, from the transverse processes of the seventh, eighth, ninth, and tenth vertebræ of the back, by as many distinct tendons, which soon grow fleshy, and then become tendinous again; and are

Inserted into the spinous processes of all the vertebræ of the back above the eighth, and into the two lowermost of the neck, by as many tendons.

Use. To extend the spine obliquely backwards.

2. *Multifidus Spinæ,*

Arises from the side and spinous processes of the os sacrum, and from the posterior part of the os ilium, where it joins with the sacrum; from all the oblique and transverse processes of the vertebræ of the loins; from all the transverse processes of the vertebræ of the back, and from those of the neck, except the three first, by as many distinct tendons, which soon grow fleshy, run in an oblique direction; and are

Inserted, by distinct tendons, into all the spinous processes of the vertebræ of the loins, of the back, and of the neck, except the first.

Use. When the different portions of this muscle act on one side, they extend the back obliquely, or move it laterally; but if they act together on both sides they extend the vertebræ backwards.

On the posterior part of the neck are,

1. *Semi-Spinalis Colli,*

Arises, from the transverse processes of the uppermost six vertebræ of the back, by as many distinct tendons ascending obliquely under the complexus.

Inserted into the spinous processes of all the vertebræ of the neck, except the first and the last.

Use. To extend the neck obliquely backwards.

2. *Transversalis Colli,*

Arises from the transverse processes of the five uppermost vertebræ of the back, by as many tendinous and fleshy origins; runs between the trachelo mastoideus, and splenius colli and cervicalis descendens.

Inserted into the transverse processes of all the cervical vertebræ, except the first and the last.

Use. To turn the neck obliquely backwards, and a little to one side.

Below the posterior part of the occiput are,

1. *Rectus Capitis Posticus Major,*

Arises, fleshy, from the external part of the spinous process of the second vertebræ of the neck; and grows broader in its ascent, which is not straight, but obliquely outwards.

Inserted, tendinous and fleshy, into the os occipitis, near the rectus capitis lateralis, and the insertion of the obliquus capitis superior.

Use. To pull the head backwards, and to assist a little in its rotation.

2. *Rectus Capitis Posticus Minor,*

Arises, by a narrow beginning, close to its fellow, from a little protuberance in the middle of the back part of the first vertebræ of the neck, its outer edge being covered by the rectus major.

Inserted, somewhat broad, into the sides of a dimple in the os occipitis, near its foramen magnum.

Use. To assist the rectus major in moving the head backwards.

3. *Obliquus Capitis Superior,*

Arises from the transverse process of the first vertebræ of the neck.

Inserted, tendinous and fleshy, into the os occipitis behind the back part of the mastoid portion of the temporal bone, and under the insertion of the complexus muscle.

Use. To draw the head backwards.

4. *Obliquus Capitis Inferior.*

Arises, fleshy, from the spinous process of the second vertebra of the neck, its whole length; and, forming a thick fleshy belly, is

Inserted into the transverse process of the first vertebra of the neck.

Use. To give a rotatory motion to the head.

On the side of the neck are,

1. *Scalenus Anticus,*

Arises, from the fourth, fifth, and sixth transverse processes of the first vertebra of the neck, by as many tendons.

Inserted, tendinous and fleshy, into the upper side of the first rib near its cartilage.

2. *Scalenus Medius,*

Arises, from all the transverse processes of the vertebræ of the neck, by as many strong tendons; the nerves to the superior extremity pass between it and the former.

Inserted into the upper and outer part of the first rib, from its root, to within the distance of an inch from its cartilage.

3. *Scalenus Posticus,*

Arises from the fifth and sixth transverse processes. of the vertebræ of the neck.

Inserted into the upper edge of the second rib, not far from the spine.

Use of the three scaleni: to bend the neck to one side; or, when the neck is fixed, to elevate the ribs, and to dilate the thorax.

There are a number of small muscles situated between the spinous and transverse processes of contiguous vertebræ; which are accordingly named,

1. *Interspinales Colli.*

The space between the spinous processes of the vertebræ of the neck, most of which are bifurcated, is filled up with fleshy portions; which

Arises, double, from the spinous process of the inferior vertebræ of the neck; and ascend to be

Inserted, in the same manner, into the spinous process of the superior vertebra. They are five in number.

Use. To draw these processes nearer to each other.

2. *Intertransversales Colli.*

They begin from the transverse process of the first vertebra of the back, and fill up the spaces between the transverse processes of the vertebræ ot the

neck, which are likewise bifurcated; and, consequently, there are six distinct double muscles, which

Arise from the inferior transverse process of each vertebra of the neck, and first of the back, and are

Inserted into the superior transverse processes.

Use. To draw these processes towards each other, and turn the neck a little to one side.

Interspinales Dorsi et Lumborum, and the *Intertransversales Dorsi,*

Are rather small tendons than muscles, serving to connect the spinal and transverse processes.

Intertransversales Lumborum,

Are four distinct small bundles of flesh, which fill up the spaces between the transverse processes of the vertebræ of the loins, and serve to draw them towards each other.

MUSCLES OF THE SUPERIOR EXTREMITIES.

THESE may be divided into the muscles that are situated on the scapula, on the os humeri, on the cubit or fore arm, and on the hand.

Muscles situated on the Scapula.

These are called *muscles* of the *os humeri;* and are three behind, one along its inferior costa, two before, and one beneath it.

Behind are,

1. *Supraspinatus,*

Arises, fleshy, from all that part of the base of the scapula that is above its spine; also from the spine and superior costa; passes under the acromion, and adheres to the capsular ligament of the os humeri.

Inserted, tendinous, into that part of the large

protuberance on the head of the os humeri, that is next the groove for lodging the tendon of the long head of the biceps.

Use. To raise the arm upwards; and, at the same time, to pull the caspular ligament from between the bones, that it may not be pinched.

2. *Infraspinatus,*

Arises, fleshy, from all that part of the base of the scapula that is between its spine and inferior angle; from the spine as far as the cervix of the scapula. The fibres ascend and descend obliquely towards a tendon in the middle of the muscle, which runs forwards, and adheres to the capsular ligament.

Inserted, by a thick and short tendon, into the upper and middle part of the large protuberance on the head of the os humeri.

Use. To roll the humerus outwards: to assist in raising, and in supporting it when raised; and to pull the ligament from between the bones.

N. B. These two muscles are covered with a tendinous membrane, from which a number of their fleshy fibres arise. It serves besides to strengthen their actions, and keeps them from swelling too much outwardly when in action.

3. *Teres Minor.*

Arises, fleshy, from all the round edge of the inferior costa of the scapula, and runs forwards along the inferior edge of the infraspinatus muscle, and adheres to the ligament.

Inserted, tendinous, into the back part of the large protuberance on the head of the os humeri, a little behind and below the termination of the last named muscle.

Use. To roll the humerus outwards, to draw the humerus backwards; and to prevent the ligament from being pinched between the bones.

Along the inferior costa of the scapula is,

Teres Major,

Arises, fleshy, from the inferior angle of the scapula, and from all that portion of its inferior costa that is rough and thicker than the rest; its fleshy fibres are continued over part of the infraspinatus muscle, to which they firmly adhere.

Inserted, by a broad, short, and thin tendon, into the ridge at the inner side of the groove for lodging the tendon of the long head of the biceps, along with the latissimus dorsi.

Use. To roll the humerus inwards, and to draw it backwards and downwards.

The two before the scapula are,

1. *Deltoides.*

Arises, fleshy, from all the posterior part of the clavicle that the pectoralis major does not possess; tendinous and fleshy, from the acromion, and lower margin of almost the whole spine of the scapula opposite to the insertion of the cucullaris muscle: from the origins it runs in three different directions, i. e. from the clavicle outwards and downwards; from the spine of the scapula outwards, forwards, and downwards; and from the acromion, straight downwards; and is composed of a number of fasciculi, which form a strong fleshy muscle that covers the anterior part of the joint of the os humeri.

Inserted, tendinous, into a rough protuberance in the outer side of the os humeri, near its middle, where the fibres of this muscle intermix with some part of the brachialis externus.

Use. To pull the arm directly outwards and upwards, and a little forwards or backwards, according to the different directions of its fibres.

2. *Coraco-Brachialis.*

Arises, tendinous and fleshy, from the forepart of

the coracoid process of the scapula; adhering, in its descent, to the short head of the biceps.

Inserted, tendinous and fleshy, about the middle of the internal part of the os humeri, near the origin of the third head of the triceps, called *brachialis externus*, where it sends down a thin tendinous expansion to the internal condyle of the os humeri.

Use. To raise the arm upwards and forwards.

N. B. There passes a nerve through this muscle, called *musculo cutaneus*.

The one beneath the scapula is,

Subscapularis.

Arises, fleshy, from all the base of the scapula internally, and from its superior and inferior costæ, being composed of a number of tendinous and fleshy fasciculi, which make prints on the bone; they all join together, fill up the hollow of the scapula, and pass over the joint, adhering to the capsular ligament.

Inserted, tendinous, into the upper part of the internal protuberance at the head of the os humeri.

Use. To roll the humerus inwards, and to draw it to the side of the body; and to prevent the capsular ligament from being pinched.

Muscles situated on the Os Humeri.

These are called

Muscles of the Cubit or *Fore Arm.*

They consist of two before, and two behind.

Before are,

1. *Biceps Flexor Cubiti.*

Arises, by two heads. The first and outermost called *longus*, begins tendinous from the upper edge of the glenoid cavity of the scapula; passes over the

head of the os humeri within the joint; and, in its descent without the joint, is enclosed in a groove near the head of the os humeri, by a membranous ligament that proceeds from the capsular ligament and adjacent tendons. The second, or innermost head, called *brevis*, arises, tendinous and fleshy from the coracoid process of the scapula, in common with the coraco-brachialis muscle. A little below the middle of the forepart of the os humeri, these heads unite.

Inserted, by a strong roundish tendon, into the tubercle on the upper end of the radius internally.

Use. To turn the hand supine, and to bend the fore arm.

N. B. At the bending of the elbow, where it begins to grow tendinous, it sends off an aponeurosis, which covers all the muscles on the inside of the fore arm, and joins with another tendinous membrane, which is sent off from the triceps extensor cubiti, and covers all the muscles on the outside of the fore arm, and a number of the fibres, from opposite sides, decussate each other. It serves to strengthen the muscles, by keeping them from swelling too much outwardly, when in action; and a number of their fleshy fibres take their origin from it.

2. *Brachialis Internus,*

Arises, fleshy, from the middle of the os humeri, at each side of the insertion of the deltoid muscle, covering all the inferior and forepart of this bone, runs over the joint and adheres firmly to the ligament.

Inserted, by a strong short tendon, into the coronoid process of the ulna.

Use. To bend the fore arm, and to prevent the capsular ligament of the joint from being pinched.

Behind, are

1. *Triceps Extensor Cubiti,*

Arises, by three heads; the first called *longus*, somewhat broad and tendinous, from the inferior costa of the scapula, near its cervix. The second head, called *brevis*, arises by an acute, tendinous, and fleshy beginning, from the back part of the os humeri, a little below its head, outwardly. The third, called *brachialis externus*, arises by an acute beginning, from the back part of the os humeri. These three heads unite lower than the insertion of the teres major, and cover the whole posterior part of the humerus, from which they receive addition in their descent.

Inserted into the upper and external part of the process of the alna, called *olecranon*, and partly into the condyles of the os humeri, adhering firmly to the ligament.

Use. To extend the fore arm.

2. *Anconeus,*

Arises, tendinous, from the posterior part of the external condyle of the os humeri; it soon grows fleshy, and is continued from the third head of the triceps.

Inserted, fleshy, and thin into a ridge on the outer and posterior edge of the ulna, being continued some way below the olecranon, and covered with a tendinous membrane.

Use. To assist in extending the fore arm.

Muscles situated on the Fore Arm.

These may be divided into three classes, viz.

1. The muscles which bend and extend the wrist, and of course the whole hand.
2. Those which bend and extend the fingers exclusively.

3. Those which act on the radius so as to roll it backwards and forwards on the ulna; which are called supinators and pronators.

The flexors both of the wrist and fingers, and the pronators, lie on the front of the fore arm. The extensors and the supinators on the back.

The flexors generally originate from the internal condyle of the os humeri, and the parts adjacent to it: the extensors from the external condyle of the same bone, and the parts which are near it.

In the following description they are arranged in the order in which they occur in the dissection of the arm; beginning with those which originate from the internal condyle, without regard to their particular functions.

Muscles on the anterior part of the Fore Arm.

1. *Palmaris Longus,*

Arises, tendinous, from the internal condyle of the os humeri, soon grows fleshy, and after a short progress, sends off a long slender tendon.

Inserted, into the ligamentum carpi annulare, and into a tendinous membrane that is expanded on the palm of the hand, named *aponeurosis palmaris;* which above, begins at the transverse or annular ligament of the wrist, and, below, is fixed to the roots of the fingers.

Use. To bend the hand, and to stretch the membrane that is expanded on the palm.

N. B. This muscle is sometimes wanting, but the aponeurosis palmaris is always to be found.

2 *Pronator Radii Teres,*

Arises, fleshy, from the internal condyle of the os humeri, and tendinous from the coronoid process of the ulna.

Inserted, thin, tendinous, and fleshy, into the middle of the posterior part of the radius.

Use. To roll the radius, together with the hand, inwards.

3. *Flexor Carpi Radialis,*

Arises, tendinous and fleshy, from the internal condyle of the os humeri, and from the anterior part of the upper end of the ulna, where it firmly adheres to the pronator radii teres.

Inserted, by a flat tendon, into the fore and upper part of the metacarpal bone that sustains the fore finger, after running through a fossa in the os trapezium.

Use. To bend the hand, and to assist in its pronation.

4. *Flexor Carpi Ulnaris,*

Arises, tendinous, from the internal condyle of the os humeri. It has likewise a small fleshy beginning from the outer side of the olecranon: between which and the condyle of the ulna passes to the fore arm; and a number of its fleshy fibres arise from the tendinous membrane which covers the fore arm.

Inserted, by a short strong tendon, into the os pisiforme. At a little distance from its insertion, a small ligament is sent off to the metacarpal bone that sustains the little finger.

Use. To assist the former in bending the arm.

5. *Flexor Sublimis Perforatus,*

Arises, tendinous and fleshy, from the internal condyle of the os humeri: tendinous from the coronoid process of the ulna, near the edge of the cavity that receives the head of the radius; fleshy from the tubercle of the radius; and membranous and fleshy from the middle of the forepart of the radius, where the flexor pollicis longus arises. Its fleshy belly sends

off four round tendons before it passes under the ligament of the wrist.

Inserted, into the anterior and upper part of the second bone of each finger, being, near the extremity of the first bone, divided for the passage of the perforans.

Use. To bend the second joint or phalanx of the fingers.

6. *Flexor Profundus Perforans,*

Arises, fleshy, from the external side, and upper part of the ulna, for some way downwards, and from a large share of the interosseous ligament. It splits into four tendons, a little before it passes under the ligamentum carpi annulare; and these pass through the slits in the tendons of the flexor sublimis.

Inserted into the fore and upper part of the third or last bone of all the four fingers.

Use. To bend the last joint of the fingers.

7. *Flexor Longus Pollicis Manus,*

Arises, by an acute fleshy beginning, from the upper part of the radius, immediately below its tubercle, and is continued down for some space on the forepart of this bone. It has likewise generally another origin from the internal condyle of the os humeri, which forms a distinct fleshy slip, that terminates near the upper part of the origin from the radius.

Inserted into the last joint of the thumb, after having passed its tendon under the ligament of the wrist.

Use. To bend the last joint of the thumb.*

* The thumb has but one flexor muscle on the front of the arm, although it has three extensors on the back part.

8. *Pronator Radii Quadratus,*

Arises, broad, tendinous, and fleshy, from the lower and inner part of the ulna; the fibres run transversely, to be

Inserted into the lower and anterior part of the radius, opposite to its origin.

Use. To turn the radius, together with the hand, inwards.

Muscles of the External Side and Back of the Arm.

1. *Supinator Radii Longus,*

Arises, by an acute and fleshy origin, from the external ridge of the os humeri, above the external condyle, nearly as far up as the middle of that bone.

Inserted into the outer side of the inferior extremity of the radius.

Use. To roll the radius outwards, and consequently the palm of the hand upwards.

2. *Extensor Carpi Radialis Longior,*

Arises, broad, thin, and fleshy, immediately below the supinator radii longus, from the lower part of the external ridge of the os humeri, above its external condyle.

Inserted, by a round tendon, into the posterior and upper part of the metacarpal bone that sustains the fore finger.

Use. To extend and bring the hand backwards.

3. *Extensor Carpi Radialis Brevior,*

Arises, tendinous, from the external condyle of the os humeri, and from the ligament that connects the radius to it, and runs along the outside of the radius.

Inserted, by a round tendon, into the upper and back part of the metacarpal bone that sustains the middle finger.

Use. To assist the last mentioned muscle.

4. *Extensor Carpi Ulnaris,*

Arises, tendinous, from the external condyle of the os humeri; and, in its progress, fleshy, from the middle of the ulna, where it passes over the ulna. Its round tendon is enclosed by a membranous sheath, in a groove which is situated at the extremity of the ulna.

Inserted, by its round tendon, into the posterior and upper part of the metacarpal bone that sustains the little finger.

Use. To assist the former in extending the hand.

5. *Extensor Digitorum Communis,*

Arises, by an acute, tendinous, and fleshy beginning, from the external condyle of the os humeri, where it adheres to the supinator radii brevis. Before it passes under the ligamentum carpi annulare externum, it splits into four tendons; some of which may be divided into several smaller; and about the forepart of the metacarpal bones they remit tendinous filaments to each other.

Inserted, into the posterior part of all the bones of the four fingers, by a tendinous expansion.

Use. To extend all the joints of the fingers.

6. *Supinator Radii Brevis,*

Arises, tendinous, from the external condyle of the os humeri; tendinous and fleshy, from the external and upper part of the ulna, and adheres firmly to the ligament that joins these two bones.

Inserted into the head, neck, and tubercle of the radius, near the insertion of the biceps, and ridge running from that downwards and outwards.

Use. To roll the radius outwards, and so bring the hand supine.

7. *Indicator*,

Arises, by an acute fleshy beginning, from the middle of the posterior part of the ulna; its tendon passes under the same ligament with the extensor digitorum communis, with part of which it is

Inserted into the posterior part of the fore finger.

Use. To extend the fore finger separately.

8. *Extensor Ossis Metacarpi Pollicis Manus*,

Arises, fleshy, from the middle and posterior part of the ulna, immediately below the insertion of the anconeus muscle, from the posterior part of the middle of the radius, and from the interosseous ligament.

Inserted, generally by two tendons, into the os trapezium, and upper back part of the metacarpal bone of the thumb, and often joins with the abductor pollicis.

Use. To extend the metacarpal bone of the thumb outwardly.

9. *Extensor Primi Internodii*,

Arises, fleshy, from the posterior part of the ulna near the former muscle, and from the interosseous ligament.

Inserted, tendinous, into the posterior part of the first bone of the thumb; and part of it may be traced as far as the second bone.

Use. To extend the first bone of the thumb obliquely outwards.

10. *Extensor Secundi Internodii*,

Arises, by an acute, tendinous, and fleshy beginning, from the middle back part of the ulna, and from the interosseous ligament; its tendon runs through a small groove at the inner and back part of the lower end of the radius.

Inserted, into the last bone of the thumb.

Use. To extend the last joint of the thumb obliquely backwards.

Muscles on the Palm of the Hand.

To obtain the full view of the muscles situated on the palm of the hand, it will be necessary to remove the annular or transverse ligament, which is stretched across from the projecting points of the pisiform and unciform bones on the inside of the wrist to the scaphoid and trapezium on the outside; for the purpose of retaining the tendons of the flexor muscles in their proper situation. And also, to remove from the palm of the hand the aponeurosis palmaris, which has been described with the palmaris longus muscle.

1. *Palmaris Brevis,*

Arises from the ligamentum carpi annulare, and tendinous membrane that is expanded on the palm of the hand.

Inserted, by small bundles of fleshy fibres, into the skin and fat that covers the abductor minimi digiti, and into the os pisiforme.

Use. To assist in contracting the palm of the hand.

Abductor Pollicis Manus,

Arises, by a broad, tendinous, and fleshy beginning, from the ligamentum carpi annulare, and from the os trapezium.

Inserted, tendinous, into the outer side of the root of the first phalanx of the thumb.

Use. To draw the thumb from the fingers.

3. *Flexor Ossis Metacarpi Pollicis*, or *Opponens Pollicis,*

Arises, fleshy, from the os trapezium and ligamentum carpi annulare, lying under the abductor pollicis.

Inserted, tendinous and fleshy, into the under and anterior part of the metacarpal bone of the thumb.

Use. To bring the thumb inwards, opposite to the other fingers.

4. *Flexor Brevis Pollicis Manus,*

Is divided into two portions by the tendon of the flexor longus pollicis, and is placed beneath the abductor, and at the side of the opponens. It is divided into two heads. The first arises fleshy from the volar sides of the trapezium, trapezoides, and from the contiguous part of the internal surface of the annular ligament. The second head arises from the magnum unciforme, and from the base of the metacarpal bone of the middle finger.

Inserted by the first head into the outer sesamoid bone, and by the second into the inner sesamoid bones. These bones acting the parts of patellæ, by having a tendinous connexion with the first phalanx of the thumb.

Use. To bend the first joint of the thumb.

5. *Abductor Pollicis Manus,*

Arises, fleshy, from almost the whole length of the metacarpal bone that sustains the middle finger; from thence its fibres are collected together.

Inserted, tendinous, into the inner part of the root of the first phalanx of the thumb.

Use. To pull the thumb towards the fingers.

There are four small flexors, called, from their form,

6. *Lumbricales,*

Which *arise*, thin and fleshy, from the outside of the tendons of the flexor profundus, a little above the lower edge of the ligamentum carpi annulare.

Inserted, by long slender tendons, into the outer

sides of the broad tendons of the interossei muscles, about the middle of the first joint.

Use. To increase the flexion of the fingers while the long flexors are in full action.

7. *Adductor Metacarpi Minimi Digiti Manus,*

Arises, fleshy, from the thin edge of the os unciforme, and from that part of the ligament of the wrist next to it.

Inserted, tendinous, into the inner side and anterior part of the metacarpal bone of this finger.

Use. To bend and bring the metacarpal bone of this finger towards the wrist.

8. *Flexor Parvus Minimi Digiti,*

Arises, fleshy, from the outer side of the os unciforme, and from the ligament of the wrist which joins with that bone.

Inserted, by a roundish tendon, into the inner and anterior part of the upper end of the first bone of this finger.

Use. To bend the little finger, and assist the adductor.

9 *Abductor Minimi Digiti Manus,*

Arises, fleshy, from the os pisiforme, and from that part of the ligamentum carpiannulare next it.

Inserted, tendinous, into the inner side of the upper end of the first bone of the little finger.

Use. To draw this finger from the rest.

The spaces between the metacarpal bones are occupied by muscles, called, from their situation, *interosseous.* The four following are to be seen on the palm of the hand.

Anterior Interosseous Muscles.

1. *Prior Indicis,*

Arises, tendinous and fleshy, from the upper and outer part of the metacarpal bone that sustains the fore finger.

Inserted, into the outside of that part of the tendinous expansion from the extensor digitorum communis, which covers the posterior part of the fore finger.

Use. To draw the fore finger outwards towards the thumb, and extend it obliquely.

2. *Posterior Indicis,*

Arises, tendinous and fleshy, from the root and inner part of the metacarpal bone that sustains the fore finger.

Inserted into the inner side of the tendinous expansion which is sent off from the extensor digitorum communis, along the posterior part of the fore finger.

Use. To extend the fore finger obliquely, and to draw it inwards.

3. *Prior Annularis,*

Arises, from the root of the outside of the metacarpal bone that sustains the ring finger.

Inserted, into the outside of the tendinous expansion of the extensor digitorum communis which covers the ring finger.

Use. To extend and pull the ring finger towards the thumb.

4. *Interosseous Auricularis,*

Arises, from the root and outer side of the metacarpal bone of the little finger; and is

Inserted into the outside of the tendinous expansion of the extensor digitorum communis, which covers the posterior part of the little finger.

Use. To extend and draw the little finger outwards.

On the back of the hand three muscles of the same kind are to be seen, which also appear on the palm.

Posterior Interosseous Muscles.

1. *Prior Medii,*

Arises, by two origins, from the roots of the metacarpal bones that sustain the fore and middle fingers externally, and next each other: runs along the outside of the middle finger; and, being conspicuous on both sides of the hand, is

Inserted into the outside of the tendinous expansion from the extensor digitorum communis, which covers the posterior part of the middle finger.

Use. To extend, and to draw the middle finger outwards.

2. *Posterior Medii,*

Arises, by two origins, from the roots of the metacarpal bones, next each other, that sustain the middle and ring fingers.

Inserted into the inside of the tendinous expansion from the extensor digitorum communis, which runs along the posterior part of the middle finger.

Use. To extend and draw the middle finger inwards.

3. *Posterior Annularis,*

Arises, by two origins, from the roots of the metacarpal bones that sustain the ring and little fingers, next each other.

Inserted into the inside of the tendon on the back of the ring finger.

Use. To draw the ring finger inward.

The following muscle also appears on the back of the hand.

Abductor Indicis Manus,

Arises, from the os trapezium, and from the superior part and inner side of the metacarpal bone of the thumb.

Inserted, by a short tendon, into the outer and back part of the first bone of the fore finger.

Use. To bring the fore finger towards the thumb.

MUSCLES OF THE INFERIOR EXTREMITIES.

THESE may be divided into the muscles *situated* on the *outside* of the *pelvis*, on the *thigh*, on the *leg*, and on the *foot*.

Muscles on the outside of the *pelvis*, which are called *muscles of the thigh.*

These are composed of *one layer before* and *three layers behind.*

The layer before consists of five muscles:

1. *Psoas Magnus.* } See page 215.
2. *Iliacus Internus.* }

3. *Pectinalis,*

Arises, broad and fleshy, from the upper and anterior part of the os pubis or pectinis, immediately above the foramen thyroideum.

Inserted into the anterior and upper part of the linea aspera of the os femoris, a little below the trochanter minor, by a flat and short tendon.

Use. To bring the thigh upwards and inwards, and to give it a degree of rotation outwards.

4. *Triceps Adductor Femoris,*

Under this appellation are comprehended three distinct muscles:

a. Adductor Longus Femoris,

Arises, by a strong roundish tendon, from the upper and anterior part of the os pubis, and ligament of its synchondrosis, on the inner side of the pectinalis.

Inserted, tendinous, near the middle of the posterior part of the linea aspera, being continued for some way down.

b. Adductor Brevis Femoris,

Arises, tendinous, from the os pubis near its joining with the opposite os pubis, below and behind the former.

Inserted, tendinous and fleshy, into the inner and upper part of the linea aspera, from a little below the trochanter minor, to the beginning of the insertion of the adductor longus.

c. Adductor Magnus Femoris,

Arises, a little lower down than the former, near the symphysis of the ossa pubis; tendinous and fleshy, from the tuberosity of the os ischium; the fibres run outwards and downwards.

Inserted, into almost the whole length of the linea aspera; into a ridge above the internal condyle of the os femoris; and, by a roundish long tendon, into the upper part of that condyle, a little above which the femoral artery takes a spiral turn towards the ham, passing between this muscle and the bone.

Use of these three muscles, or triceps. To bring the thigh inwards and upwards, according to the different directions of their fibres; and, in some degree, to roll the thigh outwards.

5. *Obturator Externus,*

Arises, fleshy, from the lower forepart of the os pubis, and forepart of the inner crus of the ischium; surrounds the foramen thyroideum; a number of its fibres, arising from the membrane which fills up that foramen, are collected like rays towards a centre, and pass outwards around the root of the back part of the cervix of the os femoris.

Inserted, by a strong tendon, into the cavity at the inner and back part of the root of the trochanter major, adhering in its course to the capsular ligament of the thigh bone.

Use. To roll the thigh bone obliquely outwards, and to prevent the capsular ligament from being pinched.

Behind are,

First layer,

Gluteus Maximus,

Arises, fleshy, from the posterior part of the spine of the os ilium, a little higher up than the joining of the ilium with the os sacrum, from the whole external side of the os sacrum, below the posterior spinous process of the os ilium; from the posterior sacro-ischiatic ligament, over which part of the inferior edge of this muscle hangs in a folded manner; from the os coccygis. All the fleshy fibres run obliquely forwards, and a little downwards, to form a thick broad muscle, which is divided into a number of strong fasciculi. The upper part of it covers almost the whole of the trochanter major, between which and the tendon of this muscle there is a large bursa mucosa, and where it is inseparably joined to the broad tendon of the *tensor vaginæ femoris.*

Inserted, by a strong, thick, and broad tendon into the upper and outer part of the linea aspera, which is continued from the trochanter major, for some way downwards, as far as the origin of the short head of the biceps flexor cruris—and also into the fascia femoris.

Use. To extend the thigh, by pulling it directly backwards, and a little outwards.

Second layer,

Gluteus Medius,

Arises, fleshy, from the anterior superior spinous process of the os ilium, and from all the outer edge of the spine of the ilium, except its posterior part, where it arises from the dorsum of that bone.

Inserted, by a broad tendon, into the outer and upper margin of the trochanter major.

Use. To draw the thigh bone outwards, and a little backwards; to roll the thigh bone outwards, especially when it is bended.

N. B. The anterior and upper part of this muscle is covered by a tendinous membrane, from which a number of its fleshy fibres arise, and which joins with the broad tendons of the gluteus maximus, tensor vaginæ femoris, and latissimus dorsi.

Third layer consists of four muscles.

1. *Gluteus Minimus,*

Arises, fleshy, from a ridge that is continued from the superior anterior spinous process of the os ilium, and from the middle of the dorsum of that bone, as far back as its great niche.

Inserted, by a strong tendon, into the fore and upper part of the trochanter major.

Use. To assist the former in pulling the thigh outwards and backwards, and in rolling it.

2. *Pyriformis,*

Arises, within the pelvis, by three tendinous and fleshy origins, from the second, third, and fourth pieces of the os sacrum; from thence growing gradually narrower, it passes out of the pelvis along with the posterior crural nerve, below the niche in the posterior part of the os ilium, where it receives a few fleshy fibres.

Inserted, by a roundish tendon, into the upper part of the cavity, at the inner side of the root of the trochanter major.

Use. To move the thigh a little upwards, and roll it outwards.

3. *Gemini,*

Arises, by two distinct origins; the superior from the spinous process, and the inferior from the tuberosity of the os ischium; also, from the posterior sacro-ischiatic ligament. They are both united by a tendinous fleshy membrane, and form a purse for the tendon of the obturator internus muscle, which was formerly described.

Inserted, tendinous and fleshy, into the cavity at the inner side of the root of the trochanter major, on each side of the tendon of the obturator internus, to which they firmly adhere.

Use. To roll the thigh outwards, and to preserve the tendon of the obturator internus from being hurt by the hardness of that part of the os ischium over which it passes; also, to hinder it from starting out of its place, while the muscle is in action.

4. *Quadratus Femoris,*

Arises, tendinous and fleshy, from the outside of the tuberosity of the os ischium; and, running transversely, is

Inserted, fleshy, into a rough ridge, continued from the root of the large trochanter to the root of the small one.

Use. To roll the thigh outwards.

Muscles situated on the Thigh.

These are called *muscles* of the *leg;* and consist of *one*, on the *outside; two*, on the *inside; four*, *before;* and *four*, *behind.*

Previous to the description of the muscles that are situated on the thigh and leg, it is necessary to take notice of a broad tendinous fascia or sheath; which is sent off from the back and from the tendon of the glutei and adjacent muscles.

It is a strong thick membrane on the outside of the thigh and leg; but, towards the inside of both, it gradually turns thinner, and has rather the appearance of cellular substance, than a tendinous membrane. A little below the trochanter major, it is firmly fixed to the linea aspera; and, farther down, to that part of the head of the tibia that is next the fibula; where it sends off the tendinous expansion along the outside of the leg.

It serves to strengthen the action of the muscles, by keeping them firm in their proper places while in action, particularly the tendons that pass over the joints where this membrane is thickest; and it gives origin to a number of the fleshy fibres of the muscles.

On the outside is,

Tensor Vaginæ Femoris,

Arises, by a narrow, tendinous, and fleshy beginning, from the external part of the anterior superior spinous process of the os ilium.

Inserted, a little below the trochanter major, into the inner side of the membranous fascia which covers the outside of the thigh.

Use. To stretch the membranous fascia, to assist in the abduction of the thigh, and somewhat in its rotation inwards.

On the inside are,

1. *Sartorius,*

Arises, tendinous from the anterior superior spinous process of the os ilium, soon grows fleshy, runs down for some space upon the rectus, and going obliquely inwards, it passes over the vastus internus, and, about the middle of the os femoris, over part of the triceps, it runs down farther between the tendon of the adductor magnus and that of the gracilis muscles.

Inserted, by a broad and thin tendon, into the inner side of the tibia, near the inferior part of its tubercle.

Use. To bend the leg obliquely inwards, or to bring one leg across the other.

2. *Gracilis,*

Arises, by a thin tendon, from the os pubis near the symphysis of these two bones: soon grows fleshy; and, descending by the inside of the thigh, is

Inserted, tendinous, into the tibia under the sartorius.

Use. To assist the sartorius.

Before are,

1. *Rectus,*

Arises, fleshy, from the inferior anterior spinous process of the os ilium, and tendinous from the dorsum of the ilium, a little above the acetabulum; runs down over the anterior part of the cervix of the os femoris; the fibres not being straight, but running down like the plumage of a feather obliquely outwards and inwards, from a tendon in the middle.

Inserted, tendinous, into the upper part of the patella, from which a thin tendon runs down, on the forepart of this bone, to terminate in a thick strong ligament, which is sent off from the inferior part of the patella, and inserted into the tubercle of the tibia.

Use. To extend the leg, and in a powerful manner, by the intervention of the patella, like a pulley.

2. *Vastus Externus,*

Arises, broad, tendinous and fleshy, from the root of the trochanter major, and upper part of the linea aspera; its origin being continued from near the insertion of the gluteus minimus, the whole length of

the linea aspera, by fleshy fibres which run obliquely forwards to a middle tendon, where they terminate.

Inserted into a large share of the upper part of the patella; and part of it ends in an aponeurosis, which is continued down to the leg, and in its passage is firmly fixed to the head of the tibia.

Use. To extend the leg.

3. *Vastus Internus,*

Arises, tendinous and fleshy, from between the forepart of the os femoris and root of the trochanter minor, and from almost all the inside of the linea aspera, by fibres running obliquely forwards and downwards.

Inserted, tendinous, into the upper and inside of the patella, continuing fleshy lower than the vastus externus. Part of it likewise ends in an aponeurosis continued down to the leg, and fixed in its passage to the upper part of the tibia.

Use. To extend the leg.

4. *Cruralis,*

Arises, fleshy, from between the two trochanters of the os femoris, but nearer the minor, and firmly adhering to most of the forepart of the os femoris, and connected to both vasti muscles.

Inserted, tendinous, into the upper part of the patella, behind the rectus.

Use. To assist in the extension of the leg.

N. B. These four muscles *before*, being inserted into the patella, have the same effect upon the leg as if they were immediately inserted into it, by means of the strong tendon, or rather ligament, which is sent off from the inferior part of the patella to the tibia.

Behind are,

1. ***Semitendinosus,***

Arises, tendinous and fleshy, in common with the long head of the biceps, from the posterior part of the tuberosity of the os ischium; and sending down a long roundish tendon, which ends flat, is

Inserted into the inside of the ridge of the tibia, a little below its tubercle.

Use. To bend the leg backwards and a little inwards.

2. *Semimembranosus,*

Arises, tendinous, from the upper and posterior part of the tuberosity of the os ischium; sends down a broad flat tendon, which ends in a fleshy belly, and, in its descent, runs at first on the forepart of the biceps, and lower, between it and the semitendinosus.

Inserted, tendinous, into the inner and back part of the head of the tibia.

Use. To bend the leg, and bring it directly backward.

N. B. The two last form what is called the *inner hamstring.*

3. ***Biceps Flexor Cruris,***

Arises, by two distinct heads. The first, called *longus*, arises, in common with the semitendinosus, from the upper and posterior part of the tuberosity of the os ischium. The second, called *brevis*, arises from the linea aspera, a little below the termination of the gluteus maximus, by a fleshy acute beginning, which soon grows broader as is descends to join with the first head, a little above the external condyle of the os femoris.

Inserted, by a strong tendon, into the upper part of the head of the fibula.

Use. To bend the leg.

N. B. This muscle forms what is called the *outer hamstring;* and between it and the inner, the nervus popliteus, the arteria and vena poplitea, are situated.

4. *Popliteus,*

Arises, by a round tendon, from the lower and back part of the external condyle of the os femoris, then runs over the ligament that involves the joint; firmly adhering to it, and part of the semilunar cartilage. As it runs over the joint, it becomes fleshy, and the fibres run obliquely inwards, being covered with a thin tendinous membrane.

Inserted, broad, thin, and fleshy, into a ridge at the upper and internal edge of the tibia, a little below its head.

Use. To assist in bending the leg, and to prevent the capsular ligament from being pinched. After the leg is bent, this muscle serves to roll it inwards.

Muscles situated on the Leg.

These muscles may be arranged in the two general classes of flexors and extensors of the foot, and flexors and extensors of the toes; but several of them, viz. the tibiales and the peronei, produce effects which are different from flexion or extension. For the accommodation of the student of anatomy, they may be studied in the order of their position as they lie on the front, on the outside, and on the back of the leg.

Muscles on the Front of the Leg.

1. *Tibialis Anticus,*

Arises, tendinous and fleshy, from the middle of that process of the tibia, to which the fibula is connected above; then it runs down fleshy on the outside of the tibia; from which, and the upper part of the

interosseous ligament, it receives a number of distinct fleshy fibres; near the extremity of the tibia, it sends off a strong round tendon, which passes under part of the ligamentum tarsi annulare near the malleolus internus.

Inserted, tendinous, into the inside of the os cuneiform internum, and posterior end of the metatarsal bone that sustains the great toe.

Use. To bend the foot, by drawing it upwards, and, at the same time, to turn the toes inwards.

2. *Extensor Proprius Pollicis Pedis,*

Arises, by an acute, tendinous, and fleshy beginning, some way below the head and anterior part of the fibula, along which it runs to near its lower extremity, connected to it by a number of fleshy fibres, which descend obliquely towards a tendon.

Inserted, tendinous, into the posterior part of the first and last joint of the great toe.

Use. To extend the great toe.

3. *Extensor Longus Digitorum Pedis,*

Arises, tendinous and fleshy, from the upper and outer part of the head of the tibia, and from the head of the fibula where it joins with the tibia, and from the interosseous ligament; also from the tendinous fascia, which covers the upper and outside of the leg by a number of fleshy fibres; and tendinous and fleshy, from the anterior spine of the fibula, almost its whole length, where it is inseparable from the *peroneus tertius.* It splits into four round tendons, under the ligamentum tarsi annulare.

Inserted, by a flat tendon, into the root of the first joint of each of the four small toes; and is expanded over the upper side of the toes, as far as the root of the last joint.

Use. To extend all the joints of the four small toes.

N. B. A portion of this muscle, which is called

4. *Peroneus Tertius,*

Arises from the middle of the fibula, continues down to near its inferior extremity, and sends its fleshy fibres forwards to a tendon, which passes under the annular ligament, and is

Inserted into the root of the metatarsal bone that sustains the little toe.

Use. To assist in bending the foot.

Muscles on the outside of the Leg.

Peroneus Longus,

Arises, tendinous and fleshy, from the forepart of the head of the perone, or fibula, the fibres running straight down; also from the upper and external part of the fibula, where it begins to rise into a round edge; as also, from the hollow between that and its anterior edge, as far down as to reach within a hand's breadth of the ankle, by a number of fleshy fibres, which run outwards towards a tendon, that sends off a long round one, which passes through a channel at the outer ankle, in the back part of the inferior extremity of the fibula; then being reflected to the sinuosity of the os calcis, it runs along a groove in the os cuboides, above the muscles in the sole of the foot.

Inserted, tendinous, into the outside of the root of the metatarsal bone that sustains the great toe, and by some tendinous fibres in the os cuneiform internum.

Use. To move the foot outwards, and to extend it a little.

2. *Peroneus Brevis,*

Arises, by an acute fleshy beginning, from above

the middle of the external part of the fibula; from the outer side of the anterior spine of this bone; as also, from its round edge externally, the fibres running obliquely outwards towards a tendon on its external side: it sends off a round tendon which passes through the groove at the outer ankle, being there included under the same ligament with that of the preceding muscle; and a little farther, it runs through a particular one of its own.

Inserted, tendinous, into the root and external part of the metatarsal bone that sustains the little toe.

Use. To assist the former in pulling the foot outwards, and extending it a little.

Muscles on the Back of the Leg.

1. *Gastrocnemius Externus*, seu *Gemellus*,

Arises, by two distinct heads. The first head arises from the upper and back part of the internal condyle of the os femoris, and from that bone, a little above its condyle, by two distinct tendinous origins. The second head arises tendinous from the upper and back part of the external condyle of the os femoris. A little below the joint, their fleshy bellies unite in a middle tendon; and, below the middle of the tibia, it sends off a broad thin tendon, which joins a little above the extremity of the tibia with the tendon of the following.

2. *Soleus*, seu *Gastrocnemius Internus*,

Arises by two origins. The first is from the upper and back part of the head of the fibula, continuing to receive many of its fleshy fibres from the posterior part of that bone for some space below its head. The other origin begins from the posterior and upper part of the middle of the tibia; and runs

inwards along the inferior edge of the popliteus towards the inner part of the tibia, from which it receives fleshy fibres for some way down. The flesh of this muscle, covered by the tendon of the gemellus, runs down nearly as far as the extremity of the tibia; a little above which the tendons of both gastrocnemii unite, and form a strong round chord, which is called *tendo Achilles*.

Inserted into the upper and posterior part of the os calcis, by the projection of which the tendo Achillis is at a considerable distance from the tibia.

Use. To extend the foot, by bringing it backwards and downwards.

3. *Plantaris,*

Arises, thin and fleshy, from the upper and back part of the root of the external condyle of the os femoris, near the inferior extremity of that bone, adhering to the ligament that involves the joint in its descent. It passes along the second origin of the soleus and under the gemellus, where it sends off a long, slender, thin tendon, which comes from between the great extensors, where they join tendons; then runs down by the inside of the tendo Achillis.

Inserted into the inside of the posterior part of the os calcis, below the tendo Achillis.

Use. To assist the former, and to pull the capsular ligament of the knee from between the bones. It seems likewise to assist in rolling the foot inwards.

4. *Flexor longus Digitorum Pedis, Profundus, Perforans,*

Arises, by an acute tendon, which soon becomes fleshy from the back part of the tibia, some way below its head, near the entry of the medullary artery; which beginning is continued down the inner edge

of this bone by short fleshy fibres, ending in its tendon; also by tendinous and fleshy fibres, from the outer edge of the tibia, and between this double order of fibres, the tibialis posticus muscle lies enclosed. Having passed under two annular ligaments, it then passes through a sinuosity at the inside of the os calcis; and, about the middle of the sole of the foot, divides into four tendons, which pass through the slits of the perforatus; and, just before its division, it receives a considerable tendon from that of the flexor pollicis longus.

Inserted into the extremity of the last joint of the four lesser toes.

Use. To bend the last joint of the toes.

5. *Tibialis Posticus.*

Arises, by a narrow fleshy beginning, from the fore and upper part of the tibia, just under the process which joins it to the fibula; then passing through a perforation in the upper part of the interrosseus ligament, it continues its origin from the back part of the fibula next the tibia, and from near one half of the upper part of the last named bone; as also, from the interosseous ligament, the fibres running towards a middle tendon, which sends off a round one that passes in a groove behind the malleolus internus.

Inserted, tendinous, into the upper and inner part of the os naviculare, being further continued to the os cuneiforme internum and medium; besides, it gives some tendinous filaments to the os calcis, os cuboides, and to the root of the metatarsal bone that sustains the middle toe.

Use. To extend the foot, and to turn the toes inwards.

6. *Flexor Longus Pollicis Pedis,*

Arises, by an acute, tendinous, and fleshy beginning, from the posterior part of the fibula, some way below its head, being continued down the same bone, almost to its inferior extremity, by a double order of oblique fleshy fibres; its tendon passes under an annular ligament at the inner ankle.

Inserted into the last joint of the great toe, and generally sends a small tendon to the os calcis.

Use. To bend the last joint of this toe.

On the upper surface of the foot, there is one muscle, viz.

Extensor Brevis Digitorum Pedis,

Arises, fleshy and tendinous, from the fore and upper part of the os calcis; and soon forms a fleshy belly, divisible into four portions, which send off an equal number of tendons that pass over the upper part of the foot, under the tendons of the former.

Inserted, by four slender tendons, into the tendinous expansion from the extensor longus which covers the small toes, except the little one; also into the tendinous expansion from the extensor pollicis, that covers the upper part of the great toe.

Use. To extend the toes.

Muscles on the Sole of the Foot.

On the sole of the foot there is a strong tendinous membrane called *Aponeurosis Plantaris*, which originates from the tuberosity of the os calcis, and proceeds forward to the toes, increasing gradually in breadth.

It is divided into three portions. That in the middle is the largest; it protects and covers the short flexor muscles, and the tendons in the middle of the foot. That on the

outside which covers the abductor and the flexor of the little toe is next in size. The internal portion, which covers the abductor of the great toe, is the smallest.

The edges of these portions dip down so as to separate the muscles they cover from each other. They are divided into five processes, corresponding with the heads of the metatarsal bones; each of these portions is divided into two bands, which are inserted into each side of the head of each metatarsal bone, and the tendons, nerves, and arteries pass between them.

Immediately under the middle portion of this aponeurosis are the common short flexors of the toes, viz.

1. *Flexor Brevis Digitorum Pedis, Sublimis Perforatus,*

Arises, by a narrow fleshy beginning, from the inferior and posterior part of a protuberance of the os calcis, between the abductors of the great and little toes, soon forms a thick fleshy belly, which sends off four tendons that split for the passage of the flexor longus.

Inserted into the second phalanx of the four lesser toes. The tendon of the little toe is often wanting.

Use. To bend the second joint of the toes.

2. *Flexor Digitorum Accessorius*, seu, *Massa Carean Jacobii Sylvii,*

Arises, by a thin fleshy origin, from most part of the sinuosity at the inside of the os calcis, which is continued forwards, for some space on the same bone; also by a thin tendinous beginning, from before the tuberosity of the os calcis externally; and, soon becoming all fleshy, is

Inserted into the tendon of the flexor longus, just at its division into four tendons.

Use. To assist the flexor longus.

3. *Lumbricales Pedis,*

Arise, by four tendinous and fleshy beginnings, from the tendon of the flexor profundus, just before its division, near the insertion of the massa carnea.

Inserted, by four slender tendons, into the inside of the first joint of the four lesser toes, and are lost in the tendinous expansion that is sent from the extensors to cover the upper part of the toes.

Use. To increase the flexion of the toes, and to draw them inwards.

On the inside of the foot, and under the common flexors, are the muscles which are considered as exclusively appropriated to the great toe, viz.

1. *Abductor Pollicis Pedis,*

Arises from the internal side of the tuberosity of the os calcis, and from a ligament which extends from this tuberosity to the sheath of the tendon of the tibialis posticus muscle, and also from the internal and inferior side of the os naviculare and cuneiform internum. It likewise *arises* from that portion of the aponeurosis plantaris, which separates it from the short flexor of the toes, and many of its fibres appear to be connected with the ligaments which pass from the posterior to the anterior bones of the foot: as it passes under the cuneiform bone, a portion of its lower surface is tendinous.

It is inseparably connected to the flexor of the great toe, and is *inserted* into the internal sesamoid bone, and the inferior and internal part of the root of the first bones of the great toe.

This muscle not only separates the great toe from the other toes, but it must increase the curvature, or arched form of the foot.

2. *Flexor Brevis Pollicis Pedis,*

Arises, tendinous, from the under and forepart of the os calcis, where it joins with the os cuboides, from the os cuneiforme externum, and is inseparably united with the abductor and adductor pollicis.

Inserted into the internal and external sesamoid bones, along with the abductor and adductor pollicis and into the root of the first joint of the great toe.

Use. To bend the first joint.

3. *Adductor Pollicis Pedis,*

Arises, by a long thin tendon, from the os calcis, from the os cuboides, from the os cuneiforme externum, and from the root of the metatarsal bone of the second toe.

Inserted into the external os sesamoideum, and root of the metatarsal bone of the great toe.

Use. To bring this toe nearer the rest.

Near the outer edge of the foot, under the second portion of the aponeurosis plantaris, are the muscles peculiar to the little toe, viz.

1. *Abductor Minimi Digiti Pedis,*

Arises, tendinous and fleshy, from the semicircular edge of a cavity on the inferior part of the protuberance of the os calcis, and from the root of the metatarsal bone of the little toe.

Inserted into the root of the first joint of the little toe externally.

Use. To draw the little toe outwards from the rest, and assist in preserving the arched form of the foot.

2. *Flexor Brevis Minimi Digiti Pedis,*

Arises, tendinous, from the os cuboides, near the sulcus or furrow for lodging the tendon of the peroneus

longus; fleshy from the outside of the metatarsal bone that sustains the little toe, below its protuberant part.

Inserted, into the anterior extremity of the metatarsal bone, and root of the first joint of this toe.

Use. To bend this toe.

Between the metatarsal bones are four external and three internal interossei: and one muscle which is common to all the metatarsal bones.

Interossei Pedis Externi, Bicipites.

1. *Abductor Indicis Pedis,*

Arises, tendinous and fleshy, by two origins, from the root of the inside of the metatarsal bone of the fore toe, from the outside of the root of the metatarsal bone of the great toe, and from the os cuneiforme internum.

Inserted, tendinous, into the inside of the root of the first joint of the fore toe.

Use. To pull the fore toe inwards from the rest of the small toes.

2. *Adductor Indicis Pedis,*

Arises, tendinous and fleshy, from the roots of the metatarsal bones of the fore and second toe.

Inserted, tendinous, into the outside of the root of the first joint of the fore toe.

Use. To pull the fore toe outwards towards the rest.

3. *Adductor Medii Digiti Pedis,*

Arises, tendinous and fleshy, from the roots of the metatarsal bones of the second and third toes.

Inserted, tendinous, into the outside of the root of the first joint of the second toe.

Use. To pull the second toe outwards.

4. *Adductor Tertii Digiti Pedis,*

Arises, tendinous and fleshy, from the roots of the metatarsal bones of the third and little toe.

Inserted, tendinous, into the outside of the root of the first joint of the third toe.

Use. To pull the third toe outwards.

Interossei Pedis Interni.

1. *Abductor Medii Digiti Pedis,*

Arises, tendinous and fleshy, from the inside of the root of the metatarsal bone of the middle toe internally.

Inserted, tendinous, into the inside of the root of the first joint of the middle toe.

Use. To pull the middle toe inwards.

2. *Abductor Tertii Digiti Pedis,*

Arises, tendinous and fleshy, from the inside and inferior part of the root of the metatarsal bone of the third toe.

Inserted, tendinous, into the inside of the root of the first joint of the third toe.

Use. To pull the third toe inwards.

3. *Abductor Minimi Digiti Pedis,*

Arises, tendinous and fleshy, from the inside of the root of the metatarsal bone of the little toe.

Inserted, tendinous, into the inside of the root of the first joint of the little toe.

Use. To pull the little toe inwards.

The common muscle,

Transversalis Pedis,

Arises, tendinous, from the under part of the anterior extremity of the metatarsal bone of the great toe,

and from the internal os sesamoideum of the first joint, adhering to the adductor pollicis.

Inserted, tendinous, into the under and outer part of the anterior extremity of the metatarsal bone of the little toe, and ligament of the next toe.

Use. To contract the foot, by bringing the great toe and the two outermost toes nearer each other.

ALPHABETICAL ARRANGEMENT

OF THE

MUSCLES.

SYSTEM OF ANATOMY.

PART III.

OF THE LIGAMENTS AND MEMBRANES WHICH CONNECT THE DIFFERENT PARTS OF THE BODY TO EACH OTHER —AND OF THE ARTICULATIONS.

CHAPTER I.

OF LIGAMENTS IN GENERAL.

The tendons and the strong membranes connected with them called aponeuroses; the fascia which bind down some of the muscles and afford an origin to many of their fibres; and the membranes which confine the tendons, appear to be composed of the same substance.

They consist of fibres which are flexible but extremely strong, and in general have but little elasticity; their surfaces are smooth and polished; their colour is whitish and silver-like.

The vessels which enter into their composition do not commonly carry red blood; and although it seems certain that they must have nerves, many very expert anatomists have declared that no nerves could be traced into them.

In a healthy state, they are entirely void of sensibility, and can be cut and punctured, or corroded with caustic applications, without pain. When inflamed, they are extremely painful.

The ligaments, which connect the different bones to each other, have a very strong resemblance to these tendinous parts, not only in their structure but in their qualities also. Many of them appear rather more firm in their texture and more vascular. Their vessels are also larger; their colour sometimes inclines to a dull white, and when examined chemically, they appear to differ in some respects from tendons.

They agree however with the tendinous parts as to their insensibility in a sound state, and the extreme pain which occurs when they are inflamed. No nerves have been traced into their structure.

Notwithstanding the ordinary insensibility of these parts, it was asserted by M. Bichat that several animals who seem to suffer no pain from cutting, puncturing, or corroding the ligaments of their joints, appeared to be in great agony when these parts were violently stretched or twisted; and he declared this to be the case when all the nerves which passed over the ligaments, and could have been affected by the process, were cut away. He explained by this the pain which sometimes occurs instantaneously in sprains, in the reduction of luxations, and in other analogous processes.

The ultimate structure of these parts is perhaps not perfectly understood.

An anatomist of the highest authority, Haller, appears to have considered them as formed of membrane, while a late writer who has paid great attention to the subject, and is also of high authority, M. Bichat, has satisfied himself that their structure is essentially fibrous.

If a tendon, or portion of tendinous membrane, be spread out, or forcibly extended, in a direction which is transverse with respect to its fibres, it will seem to be converted into a fine membrane, and the fibres will disappear to the naked eye. The same circumstances will occur when a ligament is treated in a similar way; but much more force is required.

Thus constructed, these parts are perfectly passive portions of the animal fabric, and have not more power of motion than the bones with which many of them are connected.

But notwithstanding their ordinary insensibility, they often induce a general violent affection of the system, when they are diseased. A high degree of fever, as well as severe pain, attends their acute inflammations; and hectical symptoms, in their greatest extent, are often induced by their suppurations.

There is another circumstance in their history which is very difficult to reconcile with their ordinary insensibility. They are the most common seats of gouty painful affections.

In these cases, pain does not seem to be the simple effect of inflammation; it often occurs as the first symptom of the disease; it frequently exists with great violence for a short time and goes off without inflammation, and it is frequently vicarious with affections of the most sensible and irritable parts.

Parts of a tendinous and ligamentous structure do not appear retentive of life, but lose their animation very readily, in consequence of the inflammation and other circumstances which attend wounds.

When thus deprived of life, they retain their usual appearance and their texture a long time. The dead parts separate from the living in large portions, in a way which has a considerable analogy with the exfoliation of bones.

The tendons and their expansions, and the various fasciæ, have the same chemical composition. If boiled a long time, they dissolve completely, and form the substance called by chemists, *gelatine*, or pure glue.

The ligaments differ from them in some respects. When boiled they yield a portion of gelatine, and do not dissolve entirely; but are said to retain their form and even their strength, after a very long boiling. The composition of the part so insoluble in water, has not yet been ascertained.

CHAPTER II.

A GENERAL ACCOUNT OF ARTICULATIONS AND OF BURSÆ MUCOSÆ.

SECTION I.

Of Articulations.

Those surfaces of bones which form the moveable articulations are covered with cartilaginous matter, which has been already described.* They are retained in their relative situations by ligaments, such as have been lately mentioned, which are exterior to the cavities of the articulations, and placed in such situations that they permit the motions the joints are calculated to perform, while they keep the respective bones in their proper places. They are invested in a particular manner by a thin delicate membrane, which in some joints, as those of the hip and shoulder, seems to be the internal lamina of a stronger ligament called the capsular; and in other joints, the knee for example, appears to be independent of any other structure. In each case, this synovial membrane, as it has lately been called, forms a complete sack or bag, which covers the articular surface of one bone, and is reflected from it to the corresponding surface of the other; adhering firmly to each of the articulating surfaces, and extending loosely from the margin of one surface to that of the other.

In the distribution it supplies the place of perichondrium to the cartilages, and of periosteum to those surfaces of bone with which it is connected.

It seems greatly to resemble the membranes which

* See page 3.

line the abdomen and thorax, and invests the parts contained in these cavities; and like them it may be termed a reflected membrane.

It is thin and very flexible, but dense and strong.

It secretes, or effuses from its surface, a liquor called synovia; which is particularly calculated to lubricate parts that move upon each other.

This fluid is nearly transparent: it has the consistence of a thin syrup, and is very tenacious or ropy. It mixes with cold water, and when heated becomes milky, and deposits some pellicles without losing its vicidity. It appears to be composed of eighty parts in one hundred of water; above eleven parts of fibrous matter; and between four and five parts of albumen. It also contains a small portion of soda, of muriate of soda, and of phosphate of lime.

There are in many of the joints masses of fat which appear to project into the cavity, but are exterior to the synovial membrane, and covered by it; as the viscera in the abdomen are covered by the peritoneum.

They are generally situated so as to be pressed gently, but not bruised, by the motions of the bones.

In some joints they appear like portions of the common adipose membrane; in others they appear more vascular, and have a number of blood vessels spread upon them. Small processes often project from their side like fringe.

These masses have been considered as synovial glands; but they do not appear like glands; and it is probable that the synovia is secreted by the whole internal surface of the membrane.

The synovial membrane, like the other parts of joints, is insensible in a sound state, but extremely painful when inflamed. The synovia, which is secreted, during the inflammation of this membrane, has a purulent appearance.

SECTION II.

Of Bursæ Mucosæ.

There are certain membranous cavities called bursæ mucosæ, which are found between tendons and bones, near the joints, and in other places also: which have so strong a resemblance to the synovial membrane, and are so intimately connected with some of the articulations, that they ought now to be mentioned.

They are formed of a thin dense membrane, and are attached to the surrounding parts by cellular substance; they contain a fluid like the synovia; and sometimes there are masses of fat, which although exterior to them appear to project into their cavities.

There is commonly a thin cartilage, or tough membrane, between them and the bone on which they are placed.

They often communicate with the cavities of joints, without inducing any change in the state of the part.

As they are always situated between parts that move upon each other, there is the greatest reason to believe that they are intended to lessen friction.*

These bursæ mucosæ are very numerous, as will appear from a subsequent account of them.

Several of them are very interesting on account of their connexion with very important joints.

* For further information respecting this subject, as well as joints in general, the reader is referred to a Description of the Bursæ Mucosæ of the Human Body, by Alexander Monro; to whom the world is so much indebted for the elucidation of many important points in anatomy and physiology.

CHAPTER III.

OF PARTICULAR ARTICULATIONS.

The connexion of the Hand with the Vertebræ.

The condyles of the occipital bone, and the corresponding cavities of the atlas, are covered with cartilage. The condyle and cavity on each side are invested with a synovial ligament, as decribed in the general account of articulations.

An anterior ligament descends from the front part of the great occipital foramen, and is inserted into all the front part of the atlas, between its articulating processes. That portion of this ligament which is in the middle, and inserted into the tubercle of the atlas, appears stronger, and is distinct from the rest of it.

A posterior ligament passes from the posterior margin of the occipital foramen to the upper edge of the posterior arch of the atlas.

From each side of the upper end of the tooth-like process of the vertebra dentata, a ligament passes upwards and outwards, to be inserted into the internal side of the basis of each condyle of the occipital bone.

From the anterior margin of the great occipital foramen, a ligament passes down on the inside of the vertebral cavity, over the tooth-like process, which is inserted in the body of the vertebra dentata and the ligaments connected with it.

There is also a ligament which runs across from one side of the atlas to the other, to confine the tooth-like process in its anterior cavity. This ligament adheres above to the occipital bone, and below to the body of the vertebra dentata. The anterior

surface of the tooth-like process plays on the anterior arch of the atlas; the posterior surface plays on this ligament. A synovial capsule is placed on each surface of the tooth-like process.

The articulating surfaces of the oblique processes of the atlas and vertebra dentata on each side, are invested by a synovial membrane. There are also additional ligaments placed before and behind these processes, that have an effect on their motions.

> The uses of these different ligaments are very obvious when they are dissected. The transverse ligament of the atlas, with the synovial membranes, forms an articulation for the tooth-like process, which is of a peculiar kind. The ligaments that pass from this process, to the bones of the condyles of the occipital bone, must have an effect in restraining the rotation of the head and atlas on this process, and therefore have been called moderator ligaments.

The Articulations of the Vertebræ with each other.

> To acquire a perfect idea of the construction of the Spine, it is necessary to examine, at least two preparations of it; in one of which the bodies of the vertebræ should be sawed off from the processes, so that the spinal canal may be laid open.

The bodies of all the vertebræ, except the atlas, are connected to each other by the intervertebral cartilaginous matter described in page 77, which unites them very firmly, at the same time that it allows of some motion, in consequence of its elasticity and compressibility. This connexion is strengthened by two ligaments, which extend the whole length of the spine, from the second cervical vertebra to the sacrum.

The first of these, denominated the anterior vertebral ligament, covers a considerable part of the anterior surface of the bodies of the vertebræ; it is thickest in the middle, and varies in its breadth, in

different parts of the vertebral column; it adheres very firmly to the intervertebral substance, and not so firmly to the bodies of the vertebræ. It has the shining silver-like appearance of tendon, and seems to consist entirely of longitudinal fibres. There are many fibres which appear to be connected with it, that do not extend the whole length of the spine.

On the posterior surface of the bodies of the vertebræ, in the cavity which contains the spinal marrow, is the posterior or internal vertebral ligament, which, like the anterior, extends from the upper part of the spine to the sacrum.

In its progress downwards it is broader where it is in contact with the intervertebral matter, and narrower about the middle of each of the bodies of the vertebræ. It appears to consist of longitudinal tendinous fibres, which are similar to those of the anterior ligament.

The oblique processes of the vertebræ are covered with cartilage, and are invested with a synovial membrane, like the other moveable articulations. In the neck and back these membranes are thin and delicate; but in the loins they are blended with ligamentous fibres which give them additional strength.

Some of the most curious and interesting ligaments of the spine, or indeed of the body, are those which are attached to the bony plates or arches that extend from the oblique to the spinous processes of each vertebra. These plates form a great portion of the posterior part of the vertebral canal; and the vacant spaces between them are filled up by these ligaments, which extend from the plates of each upper vertebra to those of the next vertebra below.

They are situated between the spinal process and the oblique processes on each side.

There are, therefore, two distinct ligaments between the two vertebræ, one on each side of the spinal process; and as they extend only from the

plates or arches of one vertebra to those of the other, they must necessarily be very short. They are much more conspicuous on the internal surface of the vertebral cavity than they are externally. They are thick and substantial, and very elastic; their colour resembles that of yellowish adeps; and from that circumstance they are called by some anatomists the *yellow ligaments.* They complete the cavity for the spinal marrow.

As the plates or arches to which they are connected must recede from each other, when the spine is bent forwards, it seems necessary that they should be elastic.

There are also ligaments between the spinous processes, which extend from the under surface of one spinous process to the upper surface of the spinous process below it. These are composed of tendinous shining fibres, and are sufficiently loose to permit the anterior flexure of the vertebral column. From their situation they are denominated interspinal ligaments.

There is also a thin and narrow ligamentous band, which extends from the spinous process of the seventh cervical vertebra to the spinous processes of the os sacrum, and adheres to the ends of the intermediate spinous processes. It is exterior to the tendinous origins of the trapezii and latissimi dorsi muscles. The upper portion is slightly connected to the trapezius, the lower part adheres more firmly to the latissimus dorsi.

The *ligamentum nuchæ*, as it has been denominated, is a narrow but firm strip, which extends from the spinous process of the last cervical vertebra, to the occipital bone, at or near its protuberance. That portion of the trapezius muscle, which is between the occipital bone and the seventh cervical vertebra, originates from it, or is intimately connected with it;

and a portion of the splenius muscle is also connected with it.

From the internal surface of this ligament, a thin tendinous membrane arises, whose fibres run obliquely upwards and forwards, and are inserted into the spinous processes of each of the cervical vertebræ above the seventh, and also into the atlas and the os occipitis. Attached to the ligamentum nuchæ and to the spine, this membrane seems like a partition between the muscles which lie on each side of the back of the neck.

After inspecting the different ligaments of the spine, it will be obvious that the *yellow ligaments* are among the most important of them; in consequence of their *position, their strength, and their elasticity.*

Articulation of the Lower Jaw.

The glenoid cavity of the temporal bone with the tubercle before it, and the condyle of the lower jaw, are covered with cartilages. A cartilage is placed between them, which being flexible, is accommodated to the convexity of the condyle and hollowness of the glenoid cavity, and also to the figure of the aforesaid tubercle to which it is extended. A synovial capsule, or bag, invests the glenoid cavity and the tubercle, and covers the upper surface of the cartilage. A second capsule of the same kind is attached to the condyle of the lower jaw, and the lower surface of the cartilage. A few ligamentous fibres extend from the circumference of the cavity and tubercle of the temporal bone, over both synovial capsules and the cartilage between them, to the lower jaw below the condyle, and appear to be attached to the cartilage.

These fibres are collected in such numbers, on the external and internal sides of the articulation, that they have been called the external and internal lateral ligaments.

Another ligament is mentioned which arises from

the styloid process of the temporal bone, and is inserted into the lower jaw near its angle; but this seems rather appropriated to the stylo-glossus muscle than to this articulation.

In consequence of this structure, the condyle of the lower jaw moves out of the glenoid cavity upon the tubercle, when the mouth is opened widely.

Articulation of the Clavicle and Sternum.

The connexion of the clavicle and sternum resembles strongly that of the lower jaw and temporal bone. A moveable cartilage is placed between the articulating surfaces, with a distinct synovial capsule on each side of it, applied in the usual manner to the corresponding surface of the clavicle and of the sternum. Exterior to these capsules and the intervening cartilage, are many ligamentous fibres, which are most numerous on the anterior and posterior surfaces, but diverge from each other as they proceed from the clavicle to the sternum, and are therefore called *Radiated Ligaments.*

There is a strong ligament, called the *Interclavicular*, which passes across the sternum internally, from one clavicle to the other,

And another ligament, which arises from the inferior rough surface of the clavicle, near the sternum, which is inserted into the cartilage of the first rib.

This is called the *Rhomboid, or Costo-clavicular* ligament.

Articulation of the Clavicle and Scapula.

The small surfaces of the clavicle and scapula, which are in contact with each other, are furnished with the apparatus of a moveable articulation. They are covered with cartilage, and are invested with a small synovial capsule. The upper and lower surfaces of the extremities of the clavicle

and acromion are covered by a ligamentous membrane, which is called, from its situation, the *superior* and *inferior ligament* of this articulation. But these bones are more firmly connected by the ligament which passes to the coracoid process of the scapula from the under side of the clavicle, and is very strong. Some of the fibres which compose this ligament are so arranged that they have the appearance of an inverted cone: the remaining fibres appear like another ligament, and therefore they have been called the *Trapezoid* and *Conoid* ligaments.

By their situation and strength they are enabled to retain the bones in their proper relative positions, at the same time that they permit a peculiar rotatory motion.

Articulation of the Os Humeri and Scapula.

The spherical portion of the upper extremity of the os humeri is the part of that bone which is principally concerned in the articulation, and is covered with cartilage; as is also the glenoid cavity of the scapula.

The glenoid cavity of the scapula, which is so small in the dried bone when compared with the head of the os humeri, is enlarged by the long tendon of the biceps muscle, which is attached to the upper edge of its margin, and then divides and passes down on each side of the cavity, increasing the breadth of it considerably. It appears to be blended with the cartilage that lines the cavity, and also with the capsular ligament which is exterior to it.

The articulating surface, thus composed, is perfectly regular and uniform.

The synovial ligament, in this articulation, is so blended with an external stronger ligament, that it cannot be separated in the recent subject; but notwithstanding, it is applied to the articulating sur-

faces in the same way that it is applied to the other joints forming a capsule. The stronger exterior lamina is of course only applied to that part of the synovial capsule which proceeds from the margin of one cartilaginous articulating surface to the other: it appears to be most intimately connected with the periosteum, and is rendered more firm and thick in particular parts, by the addition of fibres from the tendons of the supra and infra spinatus, and subscapularis muscles with which it is blended.

It arises from the scapula at a small distance from the margin or edge of the glenoid cavity, as formed by the tendon of the biceps, and is inserted into the os humeri at a small distance from the edge of the cartilaginous articulating surface; and, if dissected away from the bones, would appear like a cylindrical bag with both extremities open.

The long tendon of the biceps muscle, in the groove at the head of the os humeri, appears to penetrate this ligament; but it is not within the cavity of the synovial membrane; for this membrane sends down a process like the finger of a glove which lines the groove, and is reflected from its surface upon the surface of the tendon, and covers it during its whole extent, being reflected from the tendon, at its upper termination, to the adjoining surface; so that the tendon is in fact outside of the synovial capsule, which, therefore, confines the synovia completely.

This capsular ligament, which is one of the strongest, would not avail much in keeping the bones in their proper situations, if the muscles and their tendons were not disposed in such a manner that, when the muscles act, their power is excited to the same effect. In some cases of paralytic affection, where the muscles exert no influence, the weight of the arm, when it is allowed to hang without support,

draws the head of the os humeri below the glenoid cavity, notwithstanding the capsular ligament. At the same time it ought to be observed, that this ligament must be lacerated in every case of complete luxation of the os humeri; as it cannot possibly distend sufficiently to permit the separation of the bones to the extent which then takes place.

The Articulation of the Elbow.

Those surfaces of the os humeri, ulna, and radius, which move upon each other, are covered with cartilage.

The motion of the ulna and radius on the os humeri is that of the simple flexion and extension. The cylindrical head of the radius performs a part of a revolution, nearly on its own axis, without moving from the depression in the side of the ulna, with which it is in contact.

The synovial membrane adheres very firmly to the surface covered with cartilage on each of the bones, and is reflected from the margin of this surface, on one bone, to that of the others. As the principal motion performed is hinge-like, the principal ligaments are on the sides. There is also a circular ligament, which arises from the ulna and invests the narrow part of the radius immediately below its cylindrical head, like a loop, to confine the radius in contact with the ulna, and at the same time permit its motion.

This ligament is so blended with the synovial membrane that it sometimes cannot be separated from it.

The lateral ligaments are denominated from their origin and insertion, *Brachio-radial*, and *Brachio-cubital*, or *Internal* and *External*. The ligament which invests the neck of the radius is called *Coronary*, or *Orbicular*.

There are also some ligamentous bands, which run upon the front and back parts of the joint to strengthen it, which are called *Anterior* and *Posterior* accessory ligaments. Within the synovial membrane, in the upper margins of the depressions for the olecranon and coronoid processes of the ulna, are the adipose substance usually formed in joints.

Articulation of the Wrist.

The structure of the wrist is particularly complex, because it consists of three articulations, which are contiguous to each other, viz. That of the ulna and radius; of the radius and first row of carpal bones; and of the first and second row of carpal bones with each other.

An oblong convex head is formed by the upper surfaces of the scaphoides and lunare, and a portion of the upper surface of the cuneiform bone. This head is covered by one cartilage, which is so uniform that the different bones cannot be distinguished from each other. The lower end of the radius is articulated with this head, but does not cover the whole of it; a portion of this head therefore is under the ulna, but not in contact with that bone: for the cartilage which lines the concavity of the radius, is continued beyond the radius, so as to cover the remainder of the head, formed by the carpal bones. The lower end of the ulna is in contact with the upper surface of this cartilage, and is articulated laterally with the semilunar cavity of the radius. This semilunar cavity is lined by a cartilaginous process, continued from the upper surface of the aforesaid cartilage; so that the extremity and the side of the ulna play upon the cartilage continued from the radius. This articulation of the ulna and radius is distinct from that of the radius and carpus.

A synovial membrane covers the articulating head formed by the three bones of the carpus, and is re-

flected from the margin of their cartilaginous surface, to the cartilage at the end of the radius. A plait or fold of this membrane passes from the head of the carpus, at the junction of the scaphoides and lunare, to opposite part of the cartilage of the radius, and has been called the *Mucous ligament.*

A *strong ligament* is placed on the internal side of this articulation, which arises from the styloid process of the ulna, and is inserted into the anterior transverse ligament which confines the flexor tendons, and into the ligament of the os pisiforme.

Another ligament, on the external side, arises from the styloid process of the radius, and is inserted into the scaphoides, some of its fibres being continued into the aforesaid transverse ligament, and the trapezium.

There are *two* broad irregular *ligamentous membranes:* one of which arises from the anterior margin of the articulating surface of the radius; and the other from the posterior margin. One of them is inserted anteriorly, and the other posteriorly, into the margin of the corresponding surface of the scaphoides, lunare, and cuneiforme. They adhere to the synovial membrane; but in some places this membrane appears through apertures which are in them.

The surfaces, by which the first and second rows of carpal bones are articulated with each other, are very irregular. The magnum and part of the unciforme form a prominent oblong head; on each side of which is a much lower surface, formed by the trapezium and trapezoides externally, and the remaining portion of the unciforme internally.*

The scaphoides, lunare, and cuneiforme, form a cavity which corresponds with this head, and also with the lower surface formed by the unciforme;

* The palm of the hand is supposed to present forward.

while another surface of the scaphoides is articulated with the trapezium and trapezoides. These corresponding surfaces, formed by the two rows of carpal bones, irregular as they are, compose but one articulation, which is capable of a limited flexion and extension. It has a synovial membrane, with two lateral ligaments, and an anterior and posterior ligament: these last, however, are short, and can be best examined from within, by cutting open the articulation.

The bones of each row move laterally upon each other. Their lateral surfaces, which are in contact, are covered with cartilage; and the synovial sac which exists between the first and second row of bones, sends off processes between these surfaces, which are disposed like the ordinary synovial membranes in other articulations; adhering to each of the cartilaginous surfaces, while they communicate with the larger cavity between the two rows.

Articulation of the Carpal and Metacarpal Bones.

The metacarpal bones are connected to the last row of the carpus by surfaces which are covered with cartilages, and supplied with synovial membranes, as the most moveable articulations are; but the ligaments which connect these bones do not permit much motion between them. The irregularity of the articulating surfaces of the metacarpal bones of the index and middle finger also contribute to restrain their motion; and these bones accordingly move less than the other two metacarpal bones, whose surfaces are better adapted for motion.

Articulation of the Fingers.

The first joint of the fingers has a large synovial membrane, which invests the head of the metacarpal bone and the corresponding cavities of the bones of

the first phalanx. On each side is a strong lateral ligament, which arises from the side of the head of the metacarpal bone, and is inserted into the side of the base of the first phalanx.

Anteriorly there is also a ligament, which, although thick and strong, is very flexible: posteriorly the expansion of the tendons of the extensor muscle, and the tendons of the interossei, have the effect of a ligament.

The different phalanges are articulated with each other in a similar manner. The lateral ligaments are very strong: the tendon of the extensor covers the articulation posteriorly: and anteriorly, under the flexor tendons, there is a soft, but thick ligamentous substance. The metacarpal bone of the thumb differs greatly from the other metacarpal bones in its articulation with the wrist, as respects its motions. The articulating surfaces are calculated for lateral motion as well as flexion and extension; and there are no ligaments which prevent it. The first joint of the thumb resembles considerably that of the fingers; and the second joint resembles the last of the phalanges.

Articulation of the Ribs.

The ribs are connected to the bodies of the vertebræ and the intervertebral cartilages, by one articulation, and to the transverse processes of the vertebræ by another: these articulations have the ordinary apparatus for motion, with capsular ligaments, which in one case pass from the heads of the ribs to the bodies of the vertebræ, and in the other from the tubercles to the transverse processes. They are also secured in their positions by ligaments which arise from the transverse processes, and are called the *Internal* and *External Transverse Ligaments;* and also by ligaments which arise from the oblique processes.

These ligaments permit the motions necessary for respiration, and restrain all others.

The connexion of the ribs anteriorly with their cartilages, is such as admits of no motion whatever between them; but the extremities of the cartilages are articulated with the sternum, at the pits on the edges of that bone. In many instances there is no appearance of synovia between the ends of the cartilages and the sternum; but this fluid is mostly to be found in the pits, on the lower extremity of the sternum.

The Hip Joint.

The acetabulum is lined with cartilage: and the brim or margin of it is much enlarged, and the cavity deepened, by the addition of fibrous cartilaginous matter, which forms a regular smooth edge. This cartilaginous ring is continued across the upper part of the notch in the acetabulum; so that it completes the circular margin of the cavity, but leaves the under part of the notch open. The head of the os femoris is covered with cartilage, but the depression in it is still visible. From this depression a strong ligament arises, which appears to pass into the depression, near the centre of the acetabulum; but actually terminates in the lower edge of the cartilaginous ring or margin, where it crosses over the notch, and not in the bone. The thin membrane with which this ligament is invested extends to the centre of the acetabulum, and has given rise to the opinion that the ligament was inserted in the bottom of the acetabulum. There is therefore an analogy between the termination of this ligament and that of the long tendon of the biceps flexor cubiti, at the glenoid cavity of the scapula.*

This ligament allows the head of the os femoris to

* See page 284.

rise out of the acetabulum, but it is probably torn in every luxation of the os femoris.

The *capsular ligament*, which contains these articulating parts, is the strongest in the body. It arises around the acetabulum, near the basis of the cartilaginous brim, but it does not adhere to the cartilaginous edge; and it is inserted into the os femoris, near the roots of the trochanters, so that it includes a large portion of the neck of the bone. It is not every where of the same thickness and strength; for, in various places, there are additional ligamentous fibres. The largest portion of these additional fibres appears to arise from the inferior anterior spinous process of the ilium.

The synovial membrane forms the internal lamina of this ligament: it invests the articulating surfaces in the usual manner, and being reflected from the internal surface of the capsular ligament to the neck of the os femoris, it is in the place of periosteum to that part of the bone.

It seems probable that this membrane is so reflected and arranged, that the internal ligament is covered by it also, and, of course, that this ligament is exterior to the synovial membrane.

There is a considerable quantity of adipose matter, near the termination of the aforesaid internal ligament, which is also exterior to the synovial membrane: some of this can be pressed out of the acetabulum, at the vacuity in the notch under the cartilaginous margin.

Articulation of the Knee.

The synovial membrane of the knee joint is, in some places, without the support of a proper capsular ligament, or external lamen, so that it is easier distinguished in this articulation than in many others.

It adheres firmly to the cartilaginous surfaces of the os femoris, tibia and patella. and is reflected in the usual manner from one to the other of these surfaces. It arises closely from the edge of the cartilaginous surface at the top of the tibia; but on the anterior part of the os femoris, it is continued to some distance from the margin of the pulley-like surface, and the edges of the condyles. On each of the portions of the cartilaginous surface of the tibia is a cartilage of a similunar form, so placed, that its convex edge rests on the margin of the cartilaginous surface, and its concave edge is internal. These cartilages are thick at their external, and very thin at their internal edges; so that they form two superficial concavities on the top of the tibia.

Their extremities are attached by ligaments to the central protuberance of the tibia, and their anterior extremities are also connected by a ligament to each other.

The synovial membrane is so reflected as to cover the whole surface of these cartilages, except the exterior edge, which is connected with the external ligaments of the articulation.

The use of these cartilages, is evidently to form concavities on the top of the tibia, for accommodating the condyles of the os femoris: and upon examination, they will not appear so anomalous as they are at first view, for there is a considerable analogy between them and the cartilaginous edges of the glenoid cavity, and of the acetabulum.

The patella appears to project into the cavity of the joint, and its internal surface is very prominent; around the margin of this surface, and especially at the under part of it, the adipose substance found in joints is very abundant. On each side of the adipose mass, under the patella, is a plait of the synovial membrane, called *ligamentum alare minus*, and *ma-*

jus; and a process of the membrane, called *ligamentum mucosum*, passes from the neighbourhood of the adipose mass to the os femoris between the condyles.

These processes retain the adipose substance in its proper place, during the motions of the joint.

There are two very strong ligaments, called the *crucial*, which arise from the middle protuberance of the tibia, one of which is inserted posteriorly into the external condyle, and the other into the internal. These ligaments decussate each other partially, on which account the name *crucial* is applied to them. They are in a state of tension when the leg is extended, and prevent it from moving further forward: when it is bended they are relaxed. They add greatly to the strength of the connexion between the os femoris and tibia.

These ligaments are generally supposed to be in the cavity of the joint; but the synovial membrane is reflected round them in such a manner that they are exterior to it.

In addition to the crucial ligaments, this articulation has the following external supports.

When the leg is extended, these ligaments are tense, they therefore prevent rotation in the extended state: when the leg is bent, they are relaxed, and therefore admit of that motion.

1. *Two strong lateral ligaments*, one on each side of the knee. The *external* of which arises from the tubercle above the external condyle of the os femoris, and is attached to the fibula a little below its head: and the *internal*, from the upper part and tubercle of the internal condyle, and is inserted into the upper and inner part of the tibia.

2. The *posterior ligament*, whose fibres run obliquely from the external condyle, to the back part of the internal side, of the head of the tibia. This ligament also prevents the leg from being drawn too far forwards.

3. The connexion of the tendons of the extensor muscles of the leg, with this articulation, has a great effect upon it. Their insertion into the patella, places them in the situation of the upper part of an anterior ligament, of which the very strong ligament, that passes from the lower margin of the patella to the tubercle of the tibia, is only the lower portion; while the patella may be considered as an inducted part of the ligament.

Articulation of the Tibia and Fibula.

The surfaces of the upper extremities of the tibia and fibula, which are articulated with each other, are very small. When the bones are in their natural position, these surfaces are nearly horizontal, that of the tibia looking down, and that of the fibula looking up: they are covered with cartilages and have a synovial membrane. This articulation is supported by some ligamentous fibres which have been called *anterior* and *posterior ligaments;* but it is strengthened by the external lateral ligament of the knee, and by the tendon of the biceps muscle which is inserted into the upper end of the fibula.

At their lower extremities, the cartilaginous crust, which, on each of them, forms part of the articulating surface with the astragalus, is turned up on their lateral surfaces, which are in contact with each other; so that a small portion (equal in breadth only to one-sixth of an inch) of the contiguous surfaces, is covered with cartilage: the other parts of these surfaces, which are very considerable, are attached to each other by the intervention of fibrous or membranous matter, and there is very little motion of the bones on each other.

There are very strong external ligaments, anteriorly and posteriorly, which connect the fibula to the tibia; and from the posterior end of the fibula a

small short ligament passes to the nearest part of the tibia, which resembles the margins of the glenoid cavity and acetabulum; for it enlarges the articulation with the astragalus, while it serves as a ligament to the tibia and fibula.

Articulation of the Leg and Foot.

It should be observed that the tibia and fibula are so firmly connected with each other below, that they may be considered as forming but one member of this articulation.

The varied surfaces formed by the tibia and fibula, and by the astragalus, when it is contiguous to them, are invested with the usual apparatus of articulation. The synovial fluid is generally observed to be very redundant in this joint.

A lateral ligament passes downwards from the tibia at the internal malleolus, and is inserted into the inside of the astragalus, and also into the os calcis and naviculare. Some of the fibres are blended with those of the sheath for the tendon of the flexor communis; and some of them have a radiated arrangement, in consequence of which this has been called the *deltoid ligament.*

From the fibula three ligaments arise. The middle ligament, which is strong and thick, passes downwards from the end of that bone, to be inserted into the outside of the os calcis.

The anterior and posterior ligaments pass also from the external malleolus, and are inserted into the anterior and posterior portions of the astragalus.

Articulation of the Astragalus and Os Calcis.

The astragalus is attached firmly to the os calcis by very strong and short ligamentous fibres, which arise from the fossa on its under surface, and are in-

serted into the fossa between the upper articulating surfaces of the os calcis. This ligament separates the posterior articulations of the astragalus and os calcis from the anterior. The posterior articulation has a synovial membrane exclusively appropriated to it. The anterior articulation is supplied by an extension of the membrane which invests the articulating surfaces of the astragalus and naviculare.

The connexion of the astragalus, with the os calcis, is supported by the lateral ligaments of the ankle joint, and also by many irregular ligamentous fibres.

Articulation of the Astragalus with the Os Naviculare.

This articulation appears calculated for considerable motion, as well from the form of the two surfaces concerned in it, as the perfect state of their articulating investments. Their motions are restrained to a certain degree, by ligaments, which are situated on the upper and internal surfaces of the foot.

> The ligaments which pass from the anterior internal extremity of the os calcis to the os naviculare, and support the head of the astragalus, ought to be observed with attention during the examination of this joint.

Articulation of the Os Calcis and Cuboides.

The articulating surfaces of this joint are arranged in the usual manner.

There are two additional ligaments: one placed on the upper, and the other on the under surfaces of the bones. The upper ligament is thin; but the under ligament is one of the strongest of the foot; and its fibres are blended with those which form the sheath for the tendon of the peroneus longus, as it passes along the groove in the cuboides.

CHAPTER IV.

OF PARTICULAR LIGAMENTS, AND OF THE SITUATION OF THE INDIVIDUAL BURSÆ MUCOSÆ.

SECTION I.

Enumeration of the most important Ligaments, which have not been decribed.

Ligaments proper to the Scapula.

The *triangular ligament* arises, broad from the external surface of the coracoid process, and becomes narrower where it is fixed to the posterior margin of the acromion. It confines the tendon of the supraspinatus muscle, and assists in protecting the upper and inner part of the joint of the humerus.

The *posterior ligament of the scapula* is sometimes double, and is stretched across the semilunar notch of the scapula, forming that notch into one or two holes for the passage of the superior posterior scapulary vessels and nerves. It also gives rise to part of the omo-hyoideus muscle.

The Interosseous Ligament of the Fore Arm,

Extends between the sharp ridges of the radius and ulna, filling up the greater part of the space between these two bones, and is composed of small fasciculi, or fibrous slips, which run obliquely downwards and inwards. Two or three of these, however, go in the opposite direction; and one of them, termed *oblique ligament* and *chorda transversalis cubiti*, is stretched between the tubercle of the ulna and under part of the tubercle of the radius. In different parts of the ligament there are perforations for the passage of blood vessels from the fore to the back part of the bone, and a large opening is found at the upper part

of it which is filled up by muscles. It prevents the radius from rolling too much outwards, and furnishes a commodious attachment for muscles.

Ligaments retaining the Tendons of the Muscles of the Hand and Fingers in their proper positions.

The *anterior annular ligament of the wrist* is stetched across from the projecting points of the pisiform and unciform bones, to the os scaphoides and trapezium, and forms an arch which covers and preserves in their places the tendons of the flexor muscles of the fingers.

The *vaginal ligaments of the flexor tendons* are fine membranes, connecting the tendons of the sublimis, first to each other, and then to those of the profundus; forming, at the same time, bursæ mucosæ which surround the tendons.

The *vaginal* or *crucial ligaments of the phalanges*, arise from the ridges on the concave side of the phalanges, and run over the tendons of the flexor muscles of the fingers. Upon the body of the phalanges, they are thick and strong, to bind down the tendons: but over the joints they are thin, and have, in some parts, a crucial appearance, to allow the ready motion of the joints.

The *accessory ligaments of the flexor tendons of the fingers* are small tendinous fræna, arising from the first and second phalanges of the fingers. They run obliquely forwards within the vaginal ligaments, terminate in the tendons of the two flexor muscles of the fingers, and assist in keeping them in their places.

The *posterior annular ligament of the wrist* is part of the aponeurosis of the fore arm, extending across the back of the wrist, from the extremity of the ulna and os pisiforme to the extremity of the radius. It

is connected with the small annular ligaments which tie down the tendons of the extensores ossis metacarpi et primi internodii pollicis, and the extensor carpi ulnaris.

The *vaginal ligaments* adhere to the last mentioned, and serve as sheaths and bursæ mucosæ to the extensor tendons of the hand and fingers.

The *transverse ligaments*, of the extensor tendons, are aponeurotic slips running between the tendons, near the heads of the metacarpal bones, and retaining them in their places.

Ligaments on the Anterior part of the Thorax.

The *membrane proper to the sternum* is a firm expansion, composed of tendinous fibres running in different directions, and covering the anterior and posterior surfaces of the bone, being confounded with the periosteum.

The *ligaments of the cartilago ensiformis* are part of the proper membrane of the sternum, divided into strong bands, which run obliquely from the under and fore part of the second bone of the sternum, and from the cartilages of the seventh pair of ribs, to be fixed to the cartilago ensiformis. The ligaments covering the sternum serve considerably to strengthen that bone.

There are also *thin tendinous expansions* which run over the intercostal muscles at the fore part of the thorax, and connect the cartilages of the ribs to each other.

Ligaments of the Bones of the Pelvis.

The *two transverse ligaments of the pelvis* arise from the posterior part of the spine of the os ilium, and run transversely. The *superior* is fixed to the transverse process of the last vertebra of the loins; the *inferior* to the first transverse process of the os sacrum.

The *ilio sacral ligaments* arise from the posterior spinous process of the os ilium, descend obliquely, and are fixed to the first, third, and fourth spurious transverse processes of the os sacrum.

These with the two transverse ligaments, assist in binding the bones together, to which they are connected.

The *two sacro-ischiatic ligaments* are situated in the under and back part of the pelvis. They arise in common from the transverse processes of the os sacrum, and likewise from the under and lateral part of that bone, and from the upper part of the os coccygis. The first called the *large*, *external*, or *posterior*, descends obliquely, to be fixed to the tuberosity of the os ischium. The other, called the *small*, *internal* or *anterior*, runs transversely to be fixed to the spinous process of the os ischium. These two ligaments assist in binding the bones of the pelvis, in supporting its contents, and in giving origin to part of its muscles.

There are *two membranous productions* which are connected with the large sacro-ischiatic ligament, termed its *superior* and *inferior appendices.*

The *superior appendix*, which is tendinous, arises from the back part of the spine of the os ilium, and is fixed along the outer edge of the ligament, which it increases in breadth.

The *inferior* or *falciform appendix*, situated within the cavity of the pelvis, the back part of which is connected with the middle of the large external ligament, and the rest of it is extended round the curvature of the os ischium.

These two productions assist the large sacro-ischiatic ligament, in furnishing a more commodious situation for, and insertion of, part of the gluteus maximus, and obturator internus muscles.

Besides the *ilio-sacral*, and *sacro-ischiatic* liga-

ments, several other slips are observed upon the back of the os sacrum, which descend in an irregular manner, and strengthen the connexion between that bone and the os ilium.

The large holes upon the back part of the os sacrum are also surrounded with various ligamentous expansions, projecting from one tubercle to another, and giving origin to muscular fibres, and protection to small vessels and nerves which creep under them.

A general covering is sent down from the ligaments of the os sacrum, which spreads over and connects the different pieces of the os coccygis together, allowing considerable motion, as already mentioned, in the description of this bone.

The *longitudinal ligaments of the os coccygis* descend from those upon the dorsum of the os sacrum, to be fixed to the back part of the os coccygis. The ligaments of this bone prevent it from being pulled too much forwards by the action of the coccygeus muscle, and they restore the bone to its natural situation, after the muscle has ceased to act.

The *ligamentous cartilage*, which unites the two ossa pubis so firmly together as to admit of no motion, excepting in the state of pregnancy, when it is frequently found to be so much softened as to yield a little in the time of delivery.

The *obturator membrane*, or *ligament of the foramen thyroideum*, adheres to the margin of the foramen throideum, and fills the whole of that opening, excepting the oblique notch at its upper part for the passage of the obturator vessels and nerve. It assists in supporting the contents of the pelvis, and in giving origin to the obturator muscles.

The *interosseous ligament of the leg* fills the space between the tibia and fibula like the interosseous ligament of the fore arm, and is of a similar structure;

being formed of the oblique fibres, and perforated in various places for the passage of vessels and nerves.

At the upper part of it there is a large opening, where the muscles of the opposite sides are in contact; and where vessels and nerves pass to the fore part of the leg.

It serves chiefly for the origin of part of the muscles which belong to the foot.

Ligaments retaining the Tendons of the Muscles of the Foot and Toes in their proper positions.

The *annular ligament of the tarsus* is a thickened part of the aponeurosis of the leg, splitting into superior and inferior portions, which bind down the tendons of the extensors of the toes upon the fore part of the ankle.

The *vaginal ligament of the tendons of the peronei muscles*, behind the ankle is common to both, but divides at the outer part of the foot and becomes proper to each. They preserve the tendons in their places, and are the bursæ of these tendons.

The *laciniated ligament* arises from the inner ankle, and spreads in a radiated manner, to be fixed partly in the cellular substance and fat, and partly to the os calcis, at the inner side of the heel. It encloses the tibialis posticus and flexor digitorum longus.

The *vaginal ligament of the tendon of the extensor proprius pollicis* runs in a crucial direction.

The *vaginal ligament of the tendon of the flexor longus pollicis* surrounds this tendon in the hollow of the os calcis.

The *vaginal* and *crucial ligaments of the tendons of the flexors of the toes* enclose these tendons on the surfaces of the phalanges, and form their bursæ mucosæ.

The *accessary ligaments of the flexor tendons of the toes*, as in the fingers, arise from the phalanges, and are included in the sheaths of the tendons in which they terminate.

The *transverse ligaments of the extensor tendons* run between them, and preserve them in their places behind the roots of their toes.

SECTION II.

Enumeration of the most important Bursæ Mucosæ.

Those about the articulation of the shoulder are situated,

1. Under the clavicle, where it plays upon the coracoid process.
2. Between the triangular ligament of the scapula and the capsular ligament of the humerus.
3. Between the point of the coracoid process and capsular ligament of the humerus.
4. Between the tendon of the subscapularis muscle and capsular ligament of the humerus, frequently communicating with the cavity of that joint.
5. Between the origin of the coraco-brachialis and short head of the biceps, muscles and capsular ligament of the humerus.
6. Between the tendon of the teres major and the os humeri, and upper part of the tendon of the latissimus dorsi.
7. Between the tendon of the latissimus dorsi and os humeri.
8. Between the tendon of the long head of the biceps flexor cubiti and the humerus.

The bursæ marked 3 and 5 are sometimes absent.

Near the articulation of the Elbow there are,

1. With a *peloton* of fat, between the tendon of the biceps and tubercle of the radius.

2. Between the tendon common to the extensor carpi radialis brevior, extensor digitorum communis, and round head of the radius.

3. A small bursa, between the tendon of the triceps extensor cubiti and olecranon.

On the Fore Arm and Hand are situated,

1. A very large bursa surrounding the tendon of the flexor pollicis longus.

2. Four long bursæ lining the sheaths which enclose the tendons of the flexors upon the fingers.

3. Four short bursæ on the fore part of the tendons of the flexor digitorum sublimus in the palm of the hand.

4. A large bursa between the tendon of the flexor pollicis longus, the forepart of the radius, and capsular ligament of the os trapezium.

5. A large bursa between the tendons of the flexor digitorum profundus, and the forepart of the end of the radius, and capsular ligament of the wrist.

These two last mentioned bursæ are sometimes found to communicate with each other.

7. A bursa between the tendon of the flexor carpi radialis and os trapezium.

8. Between the tendon of the flexor carpi ulnaris and os pisiforme.

9. Between the tendon of the extensor ossis metacarpi pollicis and radius.

10. A large bursa common to the extensores carpi radiales, where they cross behind the extensor ossis metacarpi pollicis.

11. Another common to the extensores carpi radiales, where they cross behind the extensor secundi internodii pollicis.

12. A third, at the insertion of the tendon of the extensor carpi radialis brevior.

13. A bursa for the tendon of the extensor secundi

internodii pollicis, which communicates with the second bursa common to the extensores carpi radiales.

14. Another bursa between the tendon of the extensor secundi internodii pollicis and metacarpal bone of the thumb.

15. A bursa between the tendons of the extensor of the fore, middle, and ring fingers, and ligament of the wrist.

16. For the tendons of the extensor of the little finger.

17. Between the tendon of the extensor carpi ulnaris and ligament of the wrist.

Upon the Pelvis and upper part of the Thigh there are,

1. A very largé bursa between the iliacus internus and psoas magnus muscle, and capsular ligament of the thigh bone.

2. One between the tendon of the pectinalis muscle and the thigh bone.

3. Between the gluteus medius and trochanter major, and before the insertion of the tendon of the pyriformis.

4. Between the tendon of the gluteus minimus and trochanter major.

5. Between the gluteus maximus and vastus externus.

6. Between the gluteus medius and pyriformis.

7. Between the obturator internus and os ischium.

8. An oblong bursa continued a considerable way between the obturator internus, gemini, and capsular ligament of the thigh bone.

9. A small bursa at the head of the semimembranosus and biceps flexor cruris.

10. Between the origin of the semitendinous and that of the two former muscles.

11. A large bursa between the tendon of the gluteus maximus and root of the trochanter major.

12. Two small bursæ between the tendon of the gluteus maximus and thigh bone.

About the joint of the Knee are,

1. A large bursa behind the tendon of the extensors of the leg, frequently found to communicate with the cavity of the knee joint.

2. Behind the ligament which joins the patella to the tibia, in the upper part of the cavity of which a fatty substance projects.

3. Between the tendons of the sartorius, gracilis, semitendinosus, and tibia.

4. Between the tendons of the semimembranosus and gemellus, and ligament of the knee. This bursa contains a small one within it, from which a passage leads into the cavity of the joint of the knee.

5. Between the tendon of the semimembranosus and the lateral internal ligament of the knee, from which also there is a passage leading into the joint of the knee.

6. Under the popliteus muscle, likewise communicating with the cavity of the knee joint.

About the Ankle there are,

1. A bursa between the tendon of the tibialis anticus, and under part of the tibia and ligament of the ankle.

2. Between the tendon of the extensor proprius pollicis pedis, and the tibia and capsular ligament of the ankle.

3. Between the tendons of the extensor digitorum longus, and ligament of the ankle.

4. Common to the tendons of the peronei muscles.

5. Proper to the tendon of the peroneus brevis.

6. Between the tendon achillis and os calcis, into the cavity of which a *peloton* or mass of fat projects.

7. Between the os calcis and flexor pollicis longus.

8. Between the flexor digitorum longus and the tibia and os calcis.

9. A bursa between the tendon of the tibialis posticus and the tibia and astragalus.

On the Sole of the Foot are also,

1. A second bursa for the tendon of the peroneus longus, with an oblong peloton of fat within it.

2. One common to the tendon of the flexor pollicis longus, and that of the flexor digitorum profundus, at the upper end of which a fatty substance projects.

3. Another for the tendon of the tibialis posticus.

4. Several for the tendons of the flexors of the toes.

APPENDIX

TO THE THREE PRECEDING PARTS.

Observations on the Motions of the Skeleton.

The falling down of the body during life, when muscular action is suspended, as well as the examination of the artificial skeleton, evinces that this machine is not constructed to preserve the erect position of itself; but that when unsupported, it bends at the joints, and invariably falls forward.

It is retained in the erect position by the action of muscles: and that the muscles should produce this effect, it is necessary that they should have a fixed basis to act from.

This basis is the feet, and they are fixed to the ground by the weight of the body.

To keep the body from falling, it is necessary that the centre of gravity should be immediately over the centre of the common basis.

All our movements, both in walking, standing, and rising from our seats, are regulated by this principle; and whenever we move the body, so that the centre of gravity is changed, we must change the position of the feet, that the centre of the basis may be directly under it.

If this proposition were not almost self-evident, it might be illustrated by several very easy experiments.

If a person stand against a wall with his heels and the back parts of his legs and thighs in contact with it, and in this situation attempts to stoop forward, he will fall upon his face; there is no power in his muscles, or in any other part of the body,

when thus circumstanced, to prevent it; but a small movement forward of one foot, will enable him to stoop with ease by altering the basis of the body.

When we sit in such a position that we cannot bring the centre of gravity over the feet, the lower limbs are divested of all power of elevating the body: this is always the case when we sit with the thighs and legs at right angles with each other. Bend the knees to an acute angle, so that the feet are placed under the body, and we rise with ease.

When we wish to stoop forward without advancing one of our feet, we acquire the power in a small degree, by placing our hands behind us, to preserve the equilibrium.

Some old persons, whose spines curve forwards in consequence of age, bend their lower limbs, so that the pelvis may be projected backwards beyond the centre of the base of the body, and form a counterpoise to the upper part of the trunk.

Bending the knees alone, without projecting the pelvis backwards, will not produce this effect; for a person who stands with his back to a wall will bend his knees without obtaining this advantage, while the heels and back part of the pelvis are in contact with the wall.

When we stand with the toes pointing directly forwards, the base of the body is a square; of which the feet are two of the sides. As the positions of the feet are changed, the figure of the base and its centre necessarily changes also. When the feet are placed one immediately before the other, the centre is between the toes of the one and the heel of the other. When the position of the feet is such, that the toes point directly outwards, and the heels are opposed to each other, the centre of the base is between the heels.

In these cases, when the situation of the centre of

the base is changed, we immediately change the centre of gravity. Thus, as we turn the toes outwards, the centre of the base moves backwards; we therefore immediately make the body more erect; and by that means keep the centre of gravity over the centre of the base.

We move the centre of gravity laterally, as well as backwards and forwards, in conformity to this principle.

Thus, when we raise one foot from the ground, the body inclines so much in the opposite direction, that the centre of gravity is directly over the other. If the spine is diseased in one spot, and assumes a lateral curvature, placing the centre of gravity on one side of the natural centre of the base; another curve is formed by muscular action, in a sound part of the spine, to counteract the first, and keep the centre of gravity in its natural position.

The perception of a tendency to fall, when the centre of gravity is in a wrong situation, first induces us to make efforts to resist this tendency; we learn by experience what these efforts ought to be: and by habit we at length make them without consciousness.

As the natural tendency of the skeleton, when we stand, is to bend at the articulations, and therefore to fall forwards; the muscles which have the principal effort in keeping the body erect, must be the extensors.

Thus, the muscles on the back of the leg, and particularly the soleus, keep the tibia erect: while the muscles on the front of the thigh, the vasti and crureus, produce the same effect upon the os femoris: the bones being kept steady by the occasional counteraction of the antagonist muscles.

The whole lower limb is thus made erect by an exertion which begins at the foot, while the foot is

fixed to the ground by the weight and pressure of the body above it.

The trunk of the body has a strong tendency to bend forward at the articulations of the thigh bones and the ossa innominata. This tendency is resisted by the muscles which lie on the back part of the ossa femoris, and extend the trunk on those bones, viz. the *glutei maximi.*

The muscles which arise from the tuberosity of the ischium, and are inserted into the leg, the semitendinosus, semimembranosus, and the long head of the biceps flexor cruris, have also this effect.

The flexure of the thoracic and lumbar portions of the spine is counteracted by the sacro-lumbalis, and longissimus dorsi, which act from the sacrum and back parts of the pelvis. The *yellow ligaments*, which are *elastic*, must also co-operate to this effect: so that with regard to the spine, there is an additional agent distinct from the muscular power.

Indeed, respecting the vertebral articulations in general, it may be observed, that the connexion of the bodies of the vertebræ, by the intervertebral cartilaginous matter, and of the plates behind, by the elastic ligament, renders these articulations perfectly anomalous; and very different in their principles from the articulations in general.

In no part of the skeleton is this tendency to bend forward more strongly perceived than in the head. When we are awake, and the muscles in a healthy situation, it is effectually restrained, and the head kept erect, by the splenius and complexus, and other muscles, which act from the spine below, upon the back part of the head and the vertebræ of the neck.

When we stand on one foot, some very different muscles are called into action; the tendency of the body is to fall sidewise, towards the foot which is raised from the ground. To counteract this tendency,

the two larger peronei muscles, which are situated on the outside of the leg, act from the foot, to keep the leg erect. The vastus externus acts upon the same principle from the leg upon the os femoris. The gluteus medius and minimus, and the muscle of the fascia lata, act from the os femoris upon the pelvis and trunk; while the quadratus lumborum, and those abdominal muscles which draw the spine to that side, continue the operation: and so do likewise the muscles which act on the same side of the neck and head.

In rising from a seat, the tibialis anticus acts very powerfully, to keep the tibia erect, and prevent it from inclining backwards. The two vasti, and the crureus, raise up the os femoris: while the gluteus maximus, the semitendinosus, and semimembranosus, and the long head of the biceps, extend the trunk of the body.

There are several modes of *walking*, which are different from each other, in a small degree.

We may walk, for example, with the knee of the hind limb straight or bent, as we bring it forward. This circumstance is merely a matter of accommodation. But there are two essential processes in walking, viz. 1. Projecting one foot forward, and placing it on the ground while thus projected; and 2. Moving the body over that foot.

The mode of projecting the foot requires no explanation; but the manner of bringing it to the ground when thus advanced, ought to be noticed.

If, after standing with both feet on the same line, we move one foot forwards, suppose the right foot, it cannot be applied flat to the ground, unless we either incline the body forward or move the pelvis on the left thigh, so that the right side may present obliquely forward; or lower the right side of the pelvis, so that it may be nearer the ground.

When we incline the body forward, and thus bring the right foot to the ground, we perform the second essential process in walking along with the first: for we move the body over the fore foot. The muscles on the front part of the hind leg, and particularly the tibialis anticus, seem to produce this effect, by bending, or inclining forward, the tibia on the foot.

When the foot is brought to the ground by a rotation of the pelvis, it is likewise the tibialis anticus, and the muscles on the front of the hind leg, that move the body over it, or that begin the motion.

The gastrocnemius and soleus, and the flexors of the toes, particularly that of the great toe, occasionally co-operate with great effect. By raising the heel, and thus lengthening the hind limb, they push the body forward, and continue its motion in that direction after the effect of the tibialis anticus ceases. The length of the step appears therefore to require this elevation of the heel, and depression of the toes; but it should be observed, that when we take long steps we also turn the pelvis partly round, presenting the side obliquely forward; and in this manner increase the anterior projection of the front leg.

Although the action of the gastrocnemius, &c. seems necessary to walking with long steps; we can walk without their operation. This is proved incontestibly by the act of walking on the heel: when the gastrocnemii and the flexors are so far from acting, that they are in a state of extension. In this operation, the principal effort seems to be made by the tibialis anticus, and the muscles on the front of the leg; and the extensor muscles on the front of the thigh.

Notwithstanding these facts, the action of the gastrocnemius and soleus is essential whenever we raise the heel from the ground, while the weight of the

body presses on the front part of the foot; and it then acts with a force which equals, if it does not exceed, the weight of the body.

Jumping, at the first view of it, appears an extraordinary operation; but if a man who lies on the ground, with his feet against a wall, makes a muscular exertion, such as is necessary for jumping, the nature of the operation is very intelligible. It is a sudden *extension* of the feet and knees, and sometimes of the trunk of the body. The stroke is made against the wall; but as that does not yield, the whole motion is imprest upon the body; which is projected from the wall horizontally, in the same way that in jumping, it is projected from the ground vertically.

SYSTEM OF ANATOMY.

PART IV.

OF THE BRAIN AND SPINAL MARROW: OF THE EYE AND THE EAR.

CHAPTER I.

OF THE BRAIN.

The whole of the soft mass, which fills the cavity of the cranium, is called the brain. This mass is covered by three membranes: two of which were called *meninges* or *matres*, by the ancient anatomists: who believed that all the other membranes of the body originated from them.

These membranes are denominated the *Dura Mater*, *Tunica Arachnoidea*, and *Pia Mater*.

SECTION I.

Of the Membranes of the Brain, and Sinuses of the Dura Mater.

The *Dura Mater* encloses the brain and all its appendages, and lines the different parts of the cranium. It consists of one membrane of a very dense texture, which in several places is composed of two or more lamina. It is the thickest and strongest membrane of the body, and is composed of tendinous

fibres, which have a shining appearance, particularly on its inner surface. In many parts these fibres run in a variety of directions, and decussate each other at different angles.

The dura mater adheres every where to the surface of the cranium, in the same manner as the periosteum adheres to the bones in the other parts of the body; but is more firmly connected at the sutures and foramina than elsewhere; and so much more firmly in children than in adults, that in separating it from the cranium, it is apt to bring along with it some of the fibres of the bone to which it is attached. In the adult, the separation of the bone from the membrane is less difficult, in consequence of many of the fibres being obliterated; although in old age the adhesion is sometimes very strong.

The inner surface of the dura mater, which is remarkably smooth, is in close contact with the brain, but adheres only where the veins go into the sinuses; and is lubricated by a fluid discharged through its vessels, which guards the brain from danger, according as it may be affected by the different states of respiration.

The dura mater serves as a defence to the brain, and supplies the place of a periosteum to the inside of the cranium; giving nourishment to it, as is evident from the numerous drops of blood which appear after removing a portion of it.

The *proper* blood vessels of the dura mater are not very numerous. Its arteries are derived partly from the external carotids, and partly from the internal carotids and the vertebral arteries. Corresponding veins accompany these arteries; but the dura mater forms also reservoirs, that contain the venous blood, which is brought from the substance of the brain. These are called sinuses, and are very different from common veins.

Nerves have been traced into the dura mater by the French anatomists, derived from the sympathetic in the neck. There have been disputes respecting its sensibility; but there is reason to believe that in a sound state it has very little.

The *Tunica Arachnoidea* is an exceedingly thin, tender, and transparent membrane, in which no vessels have been hitherto observed.

It is spread uniformly over the surface of the brain, enclosing all its convolutions, without insinuating itself between any of them.

At the upper part of the brain, it adheres so closely to the subjacent coat by fine cellular substance, that it can scarcely be separated from it; but in different parts of the base of the brain, particularly about the tuber annulare and medulla oblongata, it is merely in contact with the membrane under it, and may readily be raised from it by the assistance of the blow-pipe.

The *Pia Mater*, named from its tenderness, is somewhat of the nature of the former covering, but is extremely vascular.

It covers the brain in general, enters double between all its convolutions, and lines the different cavities called *ventricles*.

It serves to conduct and support the vessels of the brain, and allows them to divide into such minute parts, as to prevent the blood from entering the tender substance of this viscus with too great force.

The arteries of the pia mater are the same with those of the brain, and are derived from the internal carotids and vertebrals.

The veins differ in no respect from those of the other viscera, excepting in this, that they do not accompany the arteries.

From the dura mater certain membranous processes go off, forming incomplete partitions, which

partially divide the cavity of the cranium; and in the same partial manner separate the parts of the brain from each other: thus preventing them from pressing upon each other, and keeping them steady.

They are formed of the internal lamina or layer of the dura mater, like a plait, and therefore each of them consists of a double membrane.

The most conspicuous of these is denominated the *falx*, which extends from the anterior to the posterior part of the cranium, and divides the upper part of the brain into two hemispheres: but it is not sufficiently deep to divide the whole of the brain; for between the under edge of it, and the base of the cranium, there is a large space occupied by a portion of the brain, which is undivided: and, therefore, common to both hemispheres.

The falx begins at the middle of the sphenoid bone, and, continuing its origin from the crista galli of the ethmoid bone, runs along the upper and middle part of the head; adhering first to the frontal, then to the joining of the parietal, and afterwards to the middle of the occipital bone.

In its passage it becomes gradually broader; and terminates behind, in the middle of the tentorium.

It runs from before backwards in a straight direction, and has some resemblance in shape to a sickle or sithe, placed with its edge downwards; from which circumstance it has obtained the name of *falx*.

After extending backwards as far as the centre of the crucial ridge, on the internal surface of the occipital bone, it extends to each side, and forms a horizontal partition, which partially divides the lower part of the cavity from the upper: but it does not extend so far forward as to separate completely the mass which is under it, or the *cerebellum*, from the upper part of the brain, or *cerebrum*.

This horizontal membrane is called the *tentorium*,

and also the *transverse septum:* it is connected behind to the inner transverse ridges and grooves of the occipital bone, and, at the fore and outer edges, to the ridges and great angles of the temporal bones, and terminates at the posterior clinoid process of the sphenoid bone.

Between the inner edge of the tentorium and the posterior clinoid process of the sphenoid bone, there is a large notch, or foramen ovale, where the brain and cerebellum are united, or where the *tuber annulare* is chiefly situated.

The tentorium keeps the falx tense, and forms a floor or vault over the cerebellum, which prevents the brain from pressing upon it.

The *falx minor*, or *septum cerebelli*, is placed between the lobes of the cerebellum. It descends from the under and back part of the falx in the middle of the tentorium, adheres to the inferior longitudinal spine of the os occipitis, and terminates insensibly at the edge of the foramen magnum of that bone.

Besides the process of the dura mater already described, there are four of inferior consideration: two of which are situated at the sides of the sella turcica, and two at the edges of the foramina lacera.

As these partitions arise like plaits from the internal surface of the dura mater, there must necessarily be a cavity, larger or smaller, between the external layer of the dura mater, which lines the internal surface of the cranium, and the basis of the partition which arises from it: this cavity must continue along the whole basis of the partition; and a section of it will be triangular.

This cavity is of considerable size at the upper edge of the falx, where it rises from the dura mater; and also where it forms the tentorium; and at the posterior edges of the tentorium, where it adheres to the occipital bone.

The cavity at the upper edge of the falx is called the *longitudinal sinus;* that at the posterior edge of the tentorium forms two cavities, called the *transverse sinuses;* and that which is at the junction of the falx and tentorium has the name of the *torcular*, or *press of Herophilus.*

The veins of the brain open into these sinuses; and the blood flows through them into the internal jugular veins. They differ from veins principally in this: that they are triangular, and, by the tension of the dura mater, are protected from pressure.

The principal sinuses are,

1. The longitudinal sinus, which begins at the crista galli, and, running along the upper edge of the falx until it arises at the tentorium, increases gradually in size, and terminates in the two lateral sinuses. [In this sinus, and beneath the dura mater near the top of the head, are many small bodies of various sizes called glandulæ pacchioni. They are of various dimensions, from a line and less to three or four lines in diameter. One of the largest of these glands on each side protrudes through the dura mater from the surface of the brain, and makes a pit in the os parietale. Vesalius demonstrated these bodies in 1543. Pacchioni also demonstrated them fifty years afterwards; and, claiming them as a discovery of his own, succeeded in attaching his name to them.]

2. The two lateral sinuses run in depressions of the occipital and temporal bones, until they terminate in the internal jugular veins at the foramen lacerum.

3. The torcular Herophili, which receives a large vein from the interior of the brain, and is situated at the junction of the falx and tentorium, opening into the longitudinal sinus, where it divides into the lateral sinuses.

These are the largest sinuses of the dura mater; but, in addition to these, there are several small sinuses: as,

4. The inferior longitudinal sinus, which is situated at the under edge of the falx, and receives blood from the central parts of the cerebrum; it terminates in the torcular Herophili, near the beginning. The other small sinuses are situated under the brain, viz.

5. The circular sinus of Ridley,* which frequently surrounds the pituitary gland, and carries the blood from the contiguous parts to the

6. Cavernous sinuses, which are placed at the sides of the sella turcica, surrounding the carotid arteries and the sixth pair of nerves, and receive blood from the circular sinuses and several contiguous parts, and discharge it into the

7. Inferior petrous sinuses, which are placed at the bases of the partes petrosæ, and discharge this blood into the ends of the lateral sinuses. To these should be added

8. The superior petrous sinuses, which are situated on the upper edges of the petrous bones. They communicate both with the lateral and the cavernous sinuses, and receive some small veins from the adjacent parts.

There are also several small sinuses near the great occipital foramen, which communicate with the lateral sinuses, and also with the vertebral veins. They are called *occipital sinuses.*

The brain, or the whole of the soft substance contained within these membranes, is composed of four portions, viz. *cerebrum*, *cerebellum*, *tuber annulare* or *pons Varolii*, and *medulla oblongata.*

* An English anatomist, who published near the end of the 17th century.

SECTION II.

Of the Cerebrum.

The *cerebrum* completely fills the upper part of the cavity of the cranium. It has some resemblance to the half of an egg, which has been divided horizontally; and is composed of two equal parts, which are separated vertically from each other by the falx. This vertical separation does not extend through the centre of the cerebrum, although it divides it completely before and behind. A portion of the central part of the cerebrum, which is situated deeper than the under edge of the falx, is not divided.

The upper surface of the two hemispheres is convex. The under surface is rather irregular: it is divided in each hemisphere into three lobes: the *anterior*, the *middle*, and the *posterior*.

The anterior lobes of the brain are situated on the front part of the base of the cranium, principally on the orbitar processes of the os frontis.

The middle lobes are lodged in the fossæ formed by the temporal and sphenoid bones.

The posterior lobes rest chiefly upon the tentorium, over the cerebellum.

Between the anterior and middle lobes is a deep furrow, corresponding to the base of the cranium on which they rest, which is called the fossa Sylvii.

The surface of the brain resembles that of a mass of small intestines, or of a convoluted cylindrical tube: it is therefore said to be convoluted. The fissures between these convolutions do not extend very deep into the substance of the brain.

The whole surface of the brain, thus convoluted, is covered by pia mater; which is connected to every part of the surface by an infinite number of small vessels and processes, that appear when this membrane is peeled off from the surface of the brain.

The mass of brain consists of two substances of different colours: one of which is, for the most part, exterior to the other. The exterior substance is of a light brown colour, and is therefore called *cineritious*, or cortical, from its situation.

The internal substance is white, and is denominated the *medullary*.

The proportion of this medullary part is much greater than that of the cortical. The cortical, however, surrounds it, so as to form the whole of the surface of the cerebrum, that can be strictly said to be exterior.

The colour of the cortical part appears to be derived from blood; as its intensity seems regularly proportioned to the quantity of blood in the head. In subjects who have been plethoric, or have had a determination of blood to the head, it is uniformly high coloured; in pallid and exhausted subjects it is of a brighter colour.

The medullary matter is uniformly white; but small red points appear upon its surface, when cut, which are the sections of vessels that carry red blood; and these points are larger and more numerous in plethoric, than in exhausted subjects. It is rather firmer than the cortical substance.

These two substances are most intimately connected in the cerebrum, and indeed seem to be a continuation of each other. In some parts they are blended together; and in other places, there are portions of cortical matter within the medullary.

The division of the cerebrum into two hemispheres extends to a considerable depth from above, and also to a considerable distance internally, from its anterior and posterior extremities; of course, the part which is undivided is in the centre.

The cortical part covers also the surfaces, which are in the great fissure that forms the two hemi-

spheres, and is occupied in a great degree by the falciform process of the dura mater. Towards the bottom of this fissure, and below the falx, these surfaces being opposed to each other, and in contact, are slightly united by adhesion of the membranes that cover them.

The central part, which is not divided, and which must appear at the bottom of the fissure, when the two hemispheres are separated from each other, is medullary; being evidently a union of the medullary matter of each hemisphere. This undivided medullary part is equal to about one half of the length of the hemispheres; the fissures at each extremity extending inwards, about one-fourth of their length. On each side of it, a fissure, equal to it in length, extends horizontally into the medullary matter in each hemisphere, about half an inch; and the whole of this unconnected surface, the middle of which is directly at the bottom of the great fissure, is termed *corpus callosum.*

When the hemispheres are cut away to the level of this surface, and the corpus callosum is examined, two raised lines appear in the middle, which extend from one end of it to the other; and between them is a small groove of the same length. This groove is called the *raphe*, or *suture* of the corpus callosum. From the raised lines or bands on each side of the raphe, small lines less elevated pass across the corpus callosum, and are lost in the medullary matter. The hemispheres being thus cut off at the level of the corpus callosum, on the cut surface is to be seen the interior mass of medullary matter, with the cortical part exterior, its edge exhibiting the convoluted surface of the brain, and the pia mater following the convolutions.

The medullary surface, thus exhibited, with the corpus callosum in the centre, is denominated the *centrum ovale.*

In the brain there are four cavities called *ventricles :* three of these are formed in the substance of the cerebrum; the fourth is situated between the cerebellum, the pons Varolii, and medulla oblongata. The two largest are called the *lateral ventricles*, from their situations; the others are named, from the order in which they occur, the *third* and the *fourth ventricle.*

The lateral ventricles are cavities of an extremely irregular figure: they are situated in each hemisphere a little below the level of the corpus callosum; and, with the exception of the partition which separates them, are directly under it. They commence anteriorly, nearly on a line with the termination of the fissure that separates the two hemispheres anteriorly; and continue backwards almost as far as the commencement of the fissure that separates them posteriorly: when they have attained this length posteriorly, they form a considerable curve, first outwards, then downwards, and afterwards forwards; so that they terminate almost as far forwards as they commenced; but much deeper.

At the posterior part of their curve, when they incline outwards, previous to their turn downwards, a process or continuation of the cavity extends backwards, almost as far as the cerebrum itself. These elongations are called the posterior *cornua* or *sinuses*, or the *digital cavities.*

Each ventrical may therefore be divided into three parts, viz. The portion under the corpus callosum, the portion which continues outwards and downwards and terminates below it; and the posterior portion.

It has been compared to a ram's horn, by some who have contemplated particularly the upper and lower portions of the cavity; and by others, who have had the whole extent in view, it has been called *tricornis.*

The bottom, or lower surface of these cavities, is varied in almost every part of its extent. The front part of the bottom of each ventricle is a broad and convex eminence, which becomes narrower as it proceeds backwards; so that it resembles a portion of a pear. It inclines outwards as well as backwards, so that the narrow posterior extremities of the two bodies are further from each other than the anterior broad extremities.

The colour of these bodies is cineritious externally; but they are striated with medullary matter within, and therefore are called *corpora striata.*

Between their posterior extremities are two other eminences, which incline to the oval form, and have a white or medullary colour; although their substance, when cut into, is slightly striated: they are called the *thalami nervorum opticorum.* These bodies are very near each other; and, being convex in form, are in contact at the centre: they adhere slightly to each other; and this adhesion is called the *soft commissure.*

The corpora striata, and the thalami nervorum opticorum, join each other at the exterior sides of the thalami: where they are in contact, there is the appearance of a narrow medullary band, which continues during the whole extent of their connexion: it has been called, by some, *tenia semicircularis*, from its form; by others *centrum geminum semicirculare.*

These surfaces constitute the bottom or floor of the first portion of the ventricles, which is under the corpus callosum: upon this floor is laid a thin lamina of the medullary matter, of a triangular form, called the *Fornix*, which covers the thalami nervorum opticorum, and is attached to them by a membrane; so that when the ventricles are opened, the bottom appears to consist of the corpora striata, and the fornix.

The upper surface or roof of the ventricles is concave; from the middle of it, immediately under the raphe of the corpus callosum, there proceeds downwards a partition of medullary matter, which separates the two ventricles from each other. This is called *septum lucidum*, from its being nearly transparent: below, it adheres to the fornix, and anteriorly, it is continued into the medullary matter, between the corpora striata. This septum lucidum is formed of two lamina or plates, which are separated from each other in the anterior portion of the septum, and thus form a small cavity, which has no communication with the other cavities of the brain.

The fornix is not perfectly flat; but, accommodated to the surface of the thalami nervorum opticorum, its under surface is rather concave, and its upper surface convex. The anterior angle passes down between the most anterior parts of the thalami nervorum opticorum: and is divided into two small portions called its *crura*, which can be traced some distance in that part of the brain.

The body of the fornix is attached to the surfaces of the thalami nervorum opticorum; on which it rests, by a very vascular membrane, which is spread over the thalami, and called *tela choroidea* and *velum interpositum.* At the edges of the fornix, there are many blood vessels in this membrane, arranged close to each other, which are called the *plexus choroides.*

The posterior side or edge of the triangular fornix terminates in the corpus callosum, or the medullary matter which is above it at that place; but the under surface is attached throughout to the parts on which it lies, by the aforesaid membrane.

The two posterior angles of the fornix form what are called the *crura;* and they terminate in the following way.

The surfaces of the inferior portions of the lateral

ventricles are not uniformly concave; but at the bottom of each, there is a prominent body, which begins where this portion of the cavity winds outward and forward, and continues its whole extent. This prominence has a curved form, and is marked by transverse indentations, towards its extremity; hence it has been termed the *hippocampus*, or *cornu ammonis.*

A similar prominence, but smaller, and without the transverse indentations, is to be found in the posterior portion of the ventricle: this has also been called *hippocampus;* but the terms *minor* and *major* are applied to distinguish them.

The posterior angles of the fornix, terminate in the large hippocampi; and the margin, or thin edge of the two anterior sides of the fornix, is continued to form an edge to the hippocampus; and is called the *tænia hippocampi*, or *corpus fimbriatum.*

The word fornix was the ancient name of a vault or arch; and from its supposed resemblance to an arch, this part has been called by that name.

When the fornix is raised up, which must be done by dividing it at the anterior angle, and detaching it from the thalami nervorum opticorum, by dissecting the *velum interpositum*, the thalami are brought fairly into view; and appear like oval bodies placed parallel to each other. They adhere slightly at their upper surfaces, and, when separated, a fissure appears between them; which is the third ventricle. At the upper and front part of this third ventricle, near its commencement, before the anterior crura of the fornix, and very near them, is a white chord, like a nerve, which passes across the ventricle, and can be traced to some distance on each side of the medullary matter of the brain.

This chord is called the *anterior commissure of the brain.* The thalami nerv: optic: being of an

oval form, and touching each other in the middle, there must be a vacuity between them at their extremities. This vacuity is behind the anterior crura of the fornix, and has been called *Vulva*, *Iter ad Infundibulum*, and *Iter ad Tertium Ventriculum.*

It leads of course into the third ventricle; but a passage continues from it downwards and rather forwards, to the infundibulum; which is a process somewhat resembling a funnel that is composed principally of cineritious substance, and passes from the lower and front part of the third ventricle, towards the sella turcica; in which is situated the small body called the *Pituitary Gland.*

The infundibulum is hollow at its commencement, and solid at its extremity near the gland.

The adhesion of the thalami nerv: optic: to each other, at the upper part of the third ventricle, has been denominated the *Commissura Mollis.* The recession from each other at their posterior extremities, in consequence of their oval figure, forms another opening into the third ventricle, when the fornix and tela choroidea is raised, which is closed when they are in their natural situations upon it.

In the back part of the third ventricle is another medullary chord, called the *posterior Commissure*, which appears much like the anterior commissure; but does not extend into the substance of the brain in the same way. Under this chord, or posterior commissure, is a passage which leads to the fourth ventricle, called *Iter ad Quartum Ventriculum*, or *Aqueduct of Sylvius.*

Behind the third ventricle, and terminating it posteriorly, are four convex bodies, called *Tubercula Quadrigemina*, or *Nates* and *Testes:* the nates are uppermost and most convex; the testes are immediately below, and somewhat oval transversely.

The nates and testes are situated so far backwards

that they are near the anterior part of the upper surface of the cerebellum, and the anterior edge of the middle of the tentorium. The posterior part of the fornix is directly over them, but it unites with the medullary matter of the cerebrum above it; there would therefore be a passage into the lateral ventricles from behind, between the back of the fornix which is above, and the nates and testes which are below; but the velum interpositum passes in from behind, and attaches the lower surface of the fornix to all the parts on which it lies; and thus closes the ventricles at this place. In this membrane, immediately over the posterior end of the fissure called the *third Ventricle*, and in contact with the nates, is the *Pineal Gland.* This body is not so large as a pea, and formed like a pine apple, or the cone of a pine tree.

When the fornix is raised, by dissecting the membrane, it may be elevated with the membrane and fornix.

The nature of this body is not understood: it resembles a small gland in its appearance, but it is very soft; and particles of sand-like matter are often found in it.

There is a small chord on each edge of the third ventricle, which appears to proceed from the pineal gland, and continues on the edge of the ventricle to the anterior crura of the fornix, which it unites to. These chords join each other under the pineal gland; they are called the *pedunculi*, or *footstalks* of the pineal gland.

The membrane connected with the pineal gland, it has been said, is the *tela choroidea*, or *velum interpositum*, in which the plexus choroides is placed, at the edges of the fornix. This membrane is extended, somewhat thinner and less vascular, so as to line the surface of the ventricles. The plexus

choroides appears to begin at the end of each of the inferior portions of the ventricles, where the pia mater penetrates from the basis of the brain: it proceeds into the upper portions of the ventricles, and continuing along the edge of the fornix, passes under that body at its inferior angle, and meets the plexus of the opposite side. Between this meeting of the plexus, and the crura of the fornix, is a vacuity of an oval figure, which forms a communication between the ventricles of the brain. Under this vacuity or foramen, the thalami nerv: optic: recede from each other, and from the anterior passage into the third ventricle, described at page 329, so that at this place the three ventricles communicate with each other.

From the plexus choroides of each side, where it has passed under the fornix at the anterior angle, a large vein is turned backwards, so as to run nearly over the fissure of the third ventricle towards the pineal gland. Several veins from the surface of the ventricle join this vein near its commencement; thus formed, it passes along with the corresponding vein from the opposite side, sometimes in contact and sometimes separated to a small distance; near the pineal gland, these veins unite into one trunk, the great internal vein of the brain, called the *Vena Galeni:* which terminates soon after in the torcular Herophili.

SECTION III.

Of the Cerebellum.

The cerebellum is situated in the lower and posterior part of the cavity of the cranium, in contact with that portion of the os occipitis which is below the grooves for the lateral sinuses. It is of course much less than the brain.

It is covered above by the tentorium, and is divided below into two lobes, by the falx minor.

The surface of the cerebellum differs in some respects from that of the cerebrum. Instead of the convolutions, there are small superficial depressions, which are nearly horizontal, tending to divide the cerebellum into strata. The pia mater extends into these depressions; and the tunica arachnoidea passes over them, as in the cerebrum.

The exterior part of the cerebellum is composed of cineritious or cortical, and the internal or medullary matter, as is the case with the cerebrum: but the proportions of these substances in the cerebellum, are the reverse of what they are in the cerebrum.

If sections be made in the cerebellum, the medullary matter is so arranged that it appears like the stem or trunk of a plant, with ramifications extending from it. This appearance has been called the *Arbor vitæ.*

On the basis of the brain is a part called *Tuber Annulare*, or *Pons Varolii*, which is formed by processes from the cerebrum and cerebellum; and is in contact with the anterior and inferior portion of the cerebellum in the middle. From this part the medulla oblongata proceeds downwards and backwards, under the cerebellum: and between the cerebellum, the medulla oblongata, and the pons Varolii, is the vacuity, called the *fourth ventricle* of the brain.

When the brain is in its natural situation this cavity is below and behind the nates and testes; and from the cerebellum there passes up to the testes a lamen of medullary matter, which closes it above. This lamen is called the *Valve of Vieussens*, or the *Valve of the Brain.* Below, the ventricle is closed by a membrane, which connects the medulla oblongata to the cerebellum.

There is a passage into this cavity from the third

ventricle, which passes under the posterior commissure and the nates and testes, and enters it below the testes.

SECTION IV.

Of the Basis of the Brain, and the Nerves which proceed from it.

When the brain is detached from the basis of the cranium, and inverted (which can be readily done, if the nerves that proceed from it are divided, as it is inverted,) the tunica arachnoidea appears more conspicuous on the basis than it is on the upper part; and the pia mater is disposed round the convolutions in the same manner that it is above; but the nerves and vessles connected with the surface of the brain are so much involved with these membranes, that considerable dissection is required to expose them properly.

The anterior and middle lobes of the brain are very conspicuous on the inverted surface. The anterior lobes appear separated from each other by the extension of the great fissure which forms the two hemispheres. The middle lobes appear at some distance from each other in the centre; and the cerebellum forms the posterior and most prominent part of the surface.

When the brain has been carefully detached from the cranium, and the nerves adhering to it are preserved, the *olfactory* or *first* pair,* of nerves, appear on the anterior lobes, running nearly parallel to each other at a small distance from the great fissure. They are flat and thin, and soft, in their texture: their breadth is rather more than one-sixth of an inch. They pass in three divisions from between the ante-

* The nerves are numbered from before.

rior and middle lobes of the cerebrum, which soon unite and run to the cribriform plate of the ethmoid, where they expand into soft bulbous lobes, from which proceed the fibres that perforate the cribriform plate, and are spread upon the schneiderian membrane.

Behind the olfactory nerves are the *optic.* Each of which comes out between the anterior and middle lobes of the cerebrum; and after bending so as to meet its fellow, turns off and passes through the optic foramen in the sphenoidal bone. These nerves can be traced in the brain to the thalami nerv: optic.

In the angle formed by the opic nerves posteriorly is a mass of softish cineritious matter; and also the infundibulum which passes to the sella turcica.

In this soft cineritious matter are two round white bodies that resemble peas; which are called the *Corpora Albicantia of Willis*, or the *Eminentiæ Mammillares.* Behind these bodies are two large medullary processes, called the *Crura Cerebri*, which are best seen if some of the cortical part of the adjoining middle lobes is dissected away. They come from the medulla of the opposite sides of the brain, and gradually approach each other until they arrive at the tuber annulare, or pons Varolii.

The Pons Varolii* is a mass of considerable size, which has a medullary appearance externally, but is striated within: it is formed by the union of the two above-mentioned crura cerebri, and of two similar processes derived from the cerebellum, called also its *Crura.* It lies over a part of the body of the sphenoid bone, and of the cuneiform process of the occipital bone, and under a portion of the middle lobes of the cerebrum and of the cerebellum. There

* Named from Varolius, physician to Gregory VIII. in 1573.

is a longitudinal depression on its surface, made by the basilar artery; and there are also many transverse streaks on it.

The crura of the cerebellum, which runs into this substance, are evidently continued from the arbor vitæ or medulla of the cerebellum.

The anterior edge of the cerebellum, part of which is in contact with the pons Varolii, is remarkably prominent on each side of it. These prominences are called the *Vermes* of the cerebellum.

The medulla oblongata is continued backwards from the posterior side of the tuber; and somewhat resembles a truncated cone inverted.

It lies on the cuneiform process of the occipital bone, and extends to the foramen magnum. It is indented lengthwise, both anteriorly and posteriorly, by fissures which are very evident: it is composed of medullary matter externally, and cineritious matter within.

On each side of the anterior fissure, which is in view when the brain is inverted, are two oblong convex bodies: those which are next to the fissure are called the *Corpora Pyramidalia*, and are the longest; the two exterior are called *Corpora Olivaria*, and are not so long.

The *third pair of nerves* come from between the crura of the cerebrum, and pass forward, diverging from each other. They proceed by the cavernous sinus, and, after penetrating the dura mater, go out of the cranium at the foramen lacerum.

The *fourth pair*, the smallest nerves of the brain, resemble sewing thread in their size and appearance. They come out between the cerebellum and pons Varolii, but can be traced backwards as far as the testes. They proceed forwards by the sides of the pons Varolii, and after penetrating the dura mater near the posterior clinoid apophysis, pass through

the foramen lacerum to the trochlearis muscles of the eye.

The *fifth pair*, the largest of the brain, arise from the crura of the cerebellum, where they unite with the pons Varolii: they pass forwards and downwards, and penetrate the dura mater near the point of the petrous portion of the temporal bone.

This nerve appears like a bundle of fibres; and, under the dura mater, forms a plexus; from which its three great branches proceed to their destination.

The *sixth pair* arise from the medulla oblongata, where it joins the pons Varolii. It is often composed of two chords on each side, one of which is very small; they pass under the pons Varolii, and through the cavernous sinus, with the carodid artery: after emerging from this sinus they proceed through the foramen lacerum to the abductor muscles of the eye. In this course a small twig passes from it, which accompanies the carotid artery through the canal in the petrous portion of the temporal bone, and, with a twig from the fifth pair, is the origin of the intercostal nerve.

The *seventh pair* appear at the side of the medulla oblongata, near the pons Varolii. It is composed on each side of two chords, called *Portio Dura* and *Portio Mollis*, and of one or more small fibres between them, called *Portio Media*. The portio mollis can be traced to the fourth ventricle. The portio dura seems to arise from the place of union of the pons Varolii with the medulla oblongata and the crura cerebelli. The portio media appears to originate in the same neighbourhood, and may be considered as an appurtenance of the portio dura. They all proceed to the meatus auditorius internus, as it has been called, in the temporal bone.

The *eighth pair of nerves* arise from the corpora olivaria on the side of the medulla oblongata.

They are composed on each of one chord called the *Glosso pharyngeal*, and of a considerable number of small filaments, which unite and form another chord called the *Par Vagum.*

With these nerves is associated a third chord called the *Spinal Accessory Nerve* of Willis, which passes up the spinal cavity, being composed of twigs from the posterior and anterior portions of almost all the cervical nerves.

The par vagum, with this nerve and the glosso-pharyngeal, proceeds from its origin to the foramen lacerum formed by the occipital and temporal bones; where they all pass out of the cranium; separated from each other, and from the internal jugular vein, by small processes of the dura mater.

Their destination is extremely different. The glosso-pharyngeal is spent upon the tongue and pharynx; the par vagum upon the contents of the thorax and abdomen, &c. while the accessory branch, which seems to have no connexion with them, perforates the sterno-mastoid muscle, and is distributed among the muscles of the shoulder.

The ninth pair arise from the corpora pyramidalia by many filaments, that are united on each side into three or four fasciculi, which perforate the dura mater separately, and then unite to pass out of the anterior condyloid foramen of the occipital bone: this pair is spent upon the muscles of the tongue.

Within the last three or four years, there have been many allusions in the public papers, to the discoveries of Dr. Gall, formerly of Vienna, respecting the brain. For information concerning these discoveries, the reader is referred to a very learned and judicious Memoir, presented to the class of Mathematical and Physical Sciences of the National Institute of France, by Messrs. Tenon, Portal, Sabatier, Pinel, and Cuvier.

A translation of this report has been published in the fifth volume of the Edinburgh Medical and Surgical Journal for 1809. See also Lessons in Practical Anatomy by the present editor, part I.

Galen taught that there were two motions in the brain, one caused by the pulsation of the arteries, the other by respiration, the air being ad-

mitted into the ventricles through the ethmoidal and sphenoidal cells. Vesalius and Fallopius refuted the latter opinion and exposed its error. In 1744, Mr. Schlichting of Amsterdam, announced to the Royal Academy of Sciences of Paris, that the brain was elevated in expiration and depressed in inspiration. MM. Haller and Lamard repeated his experiments and found that the motion of the brain depended on a reflux of blood through the internal jugulars in cases of laborious respiration, besides the common motion from the pulsation of the arteries.—See Discours sur l'Anatomie par Lassus. Ed.

CHAPTER II.

OF THE SPINAL MARROW.

The medulla oblongata is continued from the cavity of the cranium, through the great foramen of the occipital bone, into the great canal of the spine; when it takes the name of *Medulla Spinalis*, or *Spinal Marrow*.

The dura mater passes with it through the great foramen, and encloses the whole of it. At the commencement of the spinal canal this membrane is attached to the surrounding bones, viz. to the margin of the great occipital foramen, and to the atlas; but below this it is loosely connected by a membrane which sometimes appears to contain a little adeps. The tunica arachnoidea and the pia mater also invest the medulla spinalis. The arachnoidea appears unconnected with the dura mater; and it can easily be removed from the pia mater. The pia mater adheres rather firmly to the substance it encloses.

The spinal marrow consists of medullary matter externally, and cineritious or cortical matter internally.

The fissures which are observable, anteriorly, and posteriorly, in the medulla oblongata, are continued down the spinal marrow; dividing it partially into two lateral portions: these fissures penetrate to a considerable depth. Each of the lateral portions is marked on its external surface, by a more superficial fissure, which partially divides it into an anterior and posterior part; so that a transverse section of the spine has a cruciform appearance.

The nerves go off in fasciculi from the anterior and posterior surfaces of each lateral portion of the spinal marrow; so that each nerve is formed of two

fasciculi: one from before, and the other from behind. The fasciculi are of different sizes in different parts of the spine. The lowermost of the neck are large and broad; those of the back are slender; and those of the loins, and upper part of the sacrum, are very large.

The uppermost of the fasciculi of the spine proceed, almost at right angles with the medulla spinalis, to the foramina through which they pass; those which are lower pass off in a direction obliquely downwards; and the lowermost are almost perpendicular. Between the anterior and posterior fasciculi, a fine ligamentous chord passes; which is attached above to the dura mater, as it passes through the foramen magnum, and continues to the os coccygis. It passes between the tunica arachnoidea and pia mater, attached to the pia mater by cellular membrane. It sends off a small process in a lateral direction, to be attached to the dura mater in the interstices between the places where the fasciculi pass through the dura mater, and nearly in the middle between the upper and lower fasciculi.

The spinal marrow terminates in a point near the uppermost lumbar vertebra. The ligamenta denticulata of the opposite sides join each other at this point, and form a small chord, which, continuing downwards, is inserted into the os coccygis.

These ligaments may support, and keep fixed, the medulla and the nerves, as they originate from it.

As the spinal marrow terminates at the upper lumbar vertebra, the lumbar and sacral nerves go off above: they pass down like a bunch of straight twigs, and are called *Cauda Equina;* from a fancied resemblance to the tail of the horse. The sheath, formed by the dura mater for the spinal marrow, continues of its original size, and encloses them in one cavity.

The posterior and anterior fasciculi pass out separately from the dura mater, after they are out, the posterior fasciculus forms a ganglion; from which one nerve passes that joins the anterior fasciculus, and thus forms the spinal nerves.

When the nerves go off, either from the spinal canal, or the cavity of the cranium, the external lamen of the dura mater where they pass out, attaches itself to the bone or the periosteum; while an internal lamen, together with the pia mater, and perhaps the tunica arachnoidea, is continued with the nerve.

This process from the dura mater becomes so much changed, that it has been considered as cellular membrane.

The pia mater and tunica arachnoidea seem also to invest, not only the nerve in general, but the fibres of which it is composed. On this account, probably, the nerves are larger after passing through the dura mater, than they are when they leave the brain and spinal marrow.

The arteries of the spinal marrow proceed from the head, and, with several additions, continue downwards to the lumbar vertebræ.

There is generally one artery on the front surface of the medulla, which is formed by the union of two branches, that arise from the vertebral arteries within the cranium. This artery proceeds downwards and communicates with those of the neck, and with the intercostal arteries, by the intervertebral foramina, so that it preserves its size.

It terminates with the spinal marrow; and the cauda equina below it is supplied by branches from the internal iliac, which enter through the foramina of the sacrum.

There are generally two arteries on the posterior surface of the medulla spinalis, which also pass out from the cranium; arising from the vertebral arteries

or inferior arteries of the cerebellum; they have a serpentine arrangement: and communicate with each other, and with the ramifications of the anterior spinal artery.

All of these arteries are dispersed upon the spinal marrow and its membrane, and the parts immediately contiguous.

The veins correspond with the ramifications of the arteries; but they are collected into two larger branches called the *Sinus Venosi;* which are situated exterior to the dura mater, on the front and lateral sides of the spinal canal. They extend the whole length of the canal, and entering the great occipital foramen, communicate with the lateral and occipital sinuses.

CHAPTER III.

OF THE EYE.

It will be very proper to read the description of the orbit of the eye in page 62 of this volume, as an introduction to the following description of the organ.

In addition to that account of the bones, it is to be observed that processes of the dura mater pass through the foramina optica and lacera, which line the cavity of the orbit and unite with the periosteum at the margin of it.

The eye is an optical instrument of a spherical form, which lies in the orbit, in a bed of cellular membrane, more or less filled with adeps for the convenience of its motions. Connected with the ball of the eye, are several auxiliary parts, which are calculated for its motion and protection, as well as accommodation in other respects.

SECTION I.

Of the parts auxiliary to the Eye.

Above the upper margin of the orbit, on the prominences of the os frontis, called *superciliary ridges*, the adipose membrane is commonly more full than it is in the other contiguous places; and the skin which covers it is thereby rendered prominent.

The *supercilia or eyebrows* grow out of this prominent skin. The hairs which compose them are placed obliquely, with their roots towards the nose. Their principal use seems to be to defend the eye from sweat, and other matters which roll down the forehead. They are moved by the corrugator mus-

cle, and thus express certain passions; and they are also moved by the occipito-frontalis and orbicularis palpebrarum.

The Eyelids or Palpabræ,

Are formed by a slit or orifice in the skin; immediately under the skin, surrounding this orifice, is a portion of the orbicularis muscle, in the upper eyelid: under this portion of the muscle, there is a plate of cartilage; and under the cartilage, a portion of tunica conjunctiva, or membrane that covers the front part of the ball of the eye and lines the eyelids.

The upper eyelid, therefore, is composed of the skin of some fibres of the orbicularis muscle, of the cartilaginous plate, and of the tunica conjunctiva. The under eyelid is formed in the same way, with the exception of the cartilage, which, in it, is confined to the margin.

These cartilages form the margin of each eyelid, which is called *Tarsus.* The upper cartilage is broad in the middle, and narrow at each extremity, and accommodated to the form of the eyeball and eyelid. The under cartilage is a narrow flat rim which does not extend far from the margin of the eyelid. A thin delicate membrane is extended from the upper and lower margins of the orbit to these cartilages, and has been considered as forming ligaments for them.

Their edges are formed obliquely, and apply to each other in such way, that when the lids are closed a groove is formed between them and the eye; by which the tears are conveyed towards the nose.

The use of these cartilages is to keep the eyelids properly expanded; and to form margins that apply accurately to each other.

These cartilages are covered internally by the tunica conjunctiva.

The levator palpebræ muscle, which arises from the bottom of the orbit, at the upper part of the foramen opticum, and passes over the superior muscle of the eyeball; is inserted by a broad thin tendon or aponeurosis into the cartilage of the upper eyelid; and draws it upwards, within the upper margin of the orbit, when the eyelids are opened.

The tunica conjunctiva, that lines the eyelids, is continued from them, without any interruption of the surface, over the anterior part of the ball of the eye; in the same manner that the reflected membranes are continued from one surface to another.

Although this membrane is a continuation of the skin, it is essentially different from its structure; being extremely thin, flexible, and sensible, and also transparent. It abounds with vessels, which do not carry red blood in their natural state, but receive it largely when they are inflamed or much relaxed. It adheres firmly to the cartilage at the edge of the eyelids; and becomes more loose in its adhesion to the lids, as it proceeds backwards. It is so reflected to the ball of the eye, that it covers and adheres to about one-third of it anteriorly. Where it first joins the eye, the adhesion is loose, but this adhesion becomes firmer as it advances over the eye; and it cannot be separated from the cornea without maceration, and a slight degree of putrefaction. The part immediately connected with the cornea is extremely thin and delicate.

This membrane closes the orbit of the eye, and completes the cavity which contains the muscles, lachrymal gland, &c. which are by this means precluded from contact with the external air.

On the inside of each eyelid, apparently between the tunica conjunctiva and the cartilages, are a number of lines running inwards from the edge of the lid. These lines are of various lengths, from one-fourth

to near half an inch; the longest are in the middle of the upper lid. Some of them are straight; and others are serpentine: their colour is a yellowish white. There are generally more than thirty in the upper eyelid, and more than twenty in the lower. They are called the *glands of Meibomius.** By pressure a sebaceous substance can be forced out of them, in the form of fine threads, from orifices on the edges of the eyelids. They are follicles into which the sebaceous substance is secreted. This substance appears to have a twofold effect: it prevents the tears from running over the eyelid, as any other unctuous matter would do; and it prevents the eyelids from adhering to each other, in consequence of their contact during sleep.

The *eyelashes* or *cilia* are placed near the outer edge of the lower part of the cartilages of each eyelid. They are always more or less curved, and their convexities are opposed to each other. By this arrangement the eye is defended from small external objects, and from light to a certain degree, without closing the lid completely.

It is necessary, for the perfection of the eye, that the whole surface covered by the tunica conjunctiva, viz. the anterior part of the eyeball and the internal surfaces of the eyelids, should be kept perfectly flexible and moist; for this purpose the lachrymal fluid is constantly secreted, in varying quantities, by the *lachrymal gland*, formerly called *Glandula Innominata.*

This body is situated in a depression, in the upper surface of the orbit, near its external margin: it is exterior to, and above, the tunica conjunctiva. It is

* Charles Etienne demonstrated the little sebaceous glands of the eyelids, and Casserius caused them to be drawn and engraved a long time before Henry Meibomius. The latter gave his name to them by a letter printed in Helmstadt in 1666, in which they were accurately described.—See Lassus. Ed.

of an irregular oblong form, and rather flat: but it has some thickness. The under surface is lobulated, and forms two principal lobes.

From the anterior edge of the gland the excretory ducts, to the number of six or seven, pass off. They terminate at a short distance from the gland, near the upper end of the cartilage, and near the external angle of the eye. They do not communicate with each other.

Those ducts are so small they are often not to be seen by the naked eye; but there is sometimes a chain of smaller glands, which lie between the gland and the eyelid, nearly in the direction of the ducts.

The fluid secreted by this gland, (viz. the tears) is transparent; but it is always salt to the taste. When evaporated, by exposure to the air, some cubic crystals, and a small quantity of mucilaginous matter, remain. Chemistry has ascertained that these crystals contain muriate of soda and soda uncombined; and that phosphate of lime and phosphate of soda may be obtained by burning inspissated tears; but the whole of the saline matter does not amount to one-hundredth part of the tears in which they are dissolved. The tears therefore consist of these salts, and of mucus, dissolved in a large proportion of water.

The tears are carried from the eye by two small canals, which commence, one on each eyelid, at the internal extremities of the cartilages; opposite to each other.

The orifices of these canals, being in small cartilages, (but not in those called the tarsi,) are always open, and are called the *Puncta Lachrymalia.*

Each of these canals runs, within the edge of each eyelid, from the place of its commencement to the lachrymal sac; which is a larger membranous canal situated in the depression formed by the anterior portion of the os unguis and the corresponding por-

tion of the upper maxillary bone; and extending thence along the bony canal, which continues from this depression into the nose, and terminates under the inferior spongy bone near its anterior extremity.

These canals are very small at their commencement at the puncta lachrymalia; but this small portion is very short; it forms an angle with the remainder of the canal, which is considerably larger.*

The canals gradually approach each other as they proceed towards the lachrymal sac; into which they enter, in contact with each other, but by distinct orifices.

About one-fourth part of the lachrymal sac is situated above the junction of the two eyelids, or the tendon of the orbicularis muscle, and the remainder below. After it descends below the orbit of the eye, it sometimes contracts and takes the name of the *Lachrymal Duct.*

The sac and duct have some resemblance to the schneiderian membrane in structure; and are defended with a similar mucus. The membrane, of which they are composed, adheres to the periosteum of the bony canal.

The tears appear to enter the puncta lachrymalia upon the principle of capillary attraction; and to be propelled forwards by the motion of the eyelids and the pressure of the orbicularis muscle.

Between the puncta lachrymalia and the termination of the eyelids, at their junction with each other, is a small angular space, which is occupied by a body called the *Caruncula Lachrymalis;* which is of a reddish colour, with a few small hairs growing out of it: it is supposed to be glandular, and to secrete a sebaceous substance. It has an effect in directing the tears to the puncta lachrymalia.

* These canals were known to Galen, and are particularly described by Fallopius in 1584.—Ed.

Between the caruncula lachrymalis and the cornea, the tunica conjunctiva, in many persons, forms a plait or fold, which is very obvious when the eye is directed inwards; this has some analogy with the membrana nictitans of certain animals, and has been called the *Valvula Semilunaris.*

The muscles of the eye, described at page 177, &c. are to be ranked among the auxiliary appurtenances of that organ.

[At the internal corner of the eyelids is a small muscle which I had occasion to observe for the first time in the winter of 1821-2. It has, I believe, escaped the notice of other anatomists till the present time. This muscle is about three lines broad and six lines long, and arises from the posterior flat surface of the os unguis near its junction with the os æthmoides, and passes forwards and outwards, lying on the posterior face of the lachrymal ducts. As it approaches the junction of the lids, it splits into two parts, nearly equal, each of which is appropriated to a duct and inserted along its course almost to the punctum lachrymale.

To get a distinct view of it, the eyelids must be separated from the eye and turned over the nose, leaving the tendinous attachment of the orbicularis and ciliaris muscles. The semilunar valve is brought into sight by this process, which must be dissected away, and also the fat and cellular membrane beneath it. The muscle is now seen, and by passing bristles through the lachrymal ducts its connexion with them is rendered evident, at the same time that we get a good idea of its size, origin and insertion.

While making this inspection, by turning the muscles a little aside, we shall be convinced of another fact of some importance, and which is equally neglected by most anatomists. It is, that behind the tendon of the orbicularis muscle a ligamentous mat-

ter passes from the corners of the eyelids to the flat part of the os unguis, which ligament would keep the corner of the eyelids from being deformed, notwithstanding the tendon of the orbicularis be cut through in the treatment of fistula lachrymalis. The lachrymal ducts are included in this ligament, and pass through it into the sac instead of going along the edges of the eyelids, as is commonly asserted.

This muscle appears to be intended to keep the puncta in contact with the ball of the eye. Dr. Physick has suggested, that it will also keep the edges of the eyelids applied to the eyeball in cases of extreme emaciation where the eye is much sunk. While investigating this subject, my attention was called by Dr. Harlan to a motion prevailing in the puncta lachrymalia, with which I was before unacquainted. The puncta project themselves and retract much after the manner of an earth worm, and it is probable that the latter motion may be produced in some measure by this muscle.

In consideration of some of the functions of this muscle, I have ventured to propose that it be called *Tensor Tarsi.*]—Ed.*

The tendons of the four recti muscles, being spread upon the anterior part of the ball of the eye, constitute a partial covering, which has been called *Tunica Albuginea.* This tendinous expansion does not extend to the edge of the cornea, but stops short of it by several lines.†

SECTION II.

Of the Ball of the Eye.

The spherical figure of the eyeball depends upon a strong and firm external coat called the *Sclerotica;*

* For a more full account of this muscle, see Horner's Anatomy.

† By line, is meant one-twelfth of an inch.

which has an aperture in its anterior part, filled up with a transparent substance, denominated *Cornea*, that closes it perfectly.

The sclerotica is lined by a thin and delicate membrane, the *Choroides*, which is in close contact with it, but does not extend over the whole internal surface of the eye, and is deficient in the whole of the part occupied by the cornea.

On the internal surface of the choroides is spread the pulpy expansion of the optic nerve, called the *Retina;* the natual consistence of which is not much more firm than mucus.

Within these coats is a cavity, that corresponds with the figure of the sclerotica and cornea, but is divided by an incomplete membranous partition that separates the anterior part of it, which is covered by the cornea, from the remainder. This partition is called *Iris;* and it has a circular vacuity in the centre, directly opposite to the middle of the cornea, which is denominated the *Pupil.* Rays of light, which penetrate the transparent cornea, pass through the pupil into the posterior part of the eye.

The eye, thus formed, is filled with several transparent substances, called *Humours.* The greatest part of the cavity, posterior to the iris, is occupied by the vitreous humour, which is thus denominated, from its apparent resemblance to melted glass.

In front of the vitreous humour, and directly behind the pupil, is a small body with double convex surfaces, called the *Crystalline Lens.*

In the space between the lens and cornea is a thin fluid, denominated from its consistency, the *Aqueous Humour.*

Several of the parts, above enumerated, have exquisite delicacy of structure, and require a very minute description.

Of the Tunica Sclerotica.

The *Tunica Sclerotica*, or external coat of the ball of the eye, derives its name from a Greek word, which signifies to make hard. It is composed of opaque white fibres, of great firmness; which form a membrane of very close texture, that supports the globular figure of the eye. It is thicker behind than it is before; but the expansion of the tendons of the recti muscles give it a partial additional covering.

It has been considered, by many anatomists, as continued into the cornea; but it can be separated from it by putrefaction; and it is essentially different from it in structure.

The aperture in it, which is occupied by the cornea, is not perfectly circular; but inclines somewhat to the oval form: the transverse diameter being rather longer than the vertical.

Posteriorly, it is intimately connected with the optic nerve, which enters it, not directly at the extremity of the axis that passes through the centre of the cornea and pupil, but on the inside of this spot.

The optic nerve has a firm coat, which invests it rather loosely: this coat seems to be continued into, or expanded upon, the sclerotica. Within it, the delicate nerve diminishes considerably before it perforates the sclerotica, and appears to be composed of fibres. At the small place of its penetration, the sclerotica is very thin: and it seems that the nerve does not penetrate through one aperture, but these fibres pass separately through very small foramina, in this thin part. The foramina are necessarily very small, as the diameter of the whole perforated portion, in some eyes, does not exceed two lines or one-sixth of an inch.

The sclerotica, in its natural state, has few, if any, vessels, that carry red blood. The great vas-

cularity, which is so evident in ophthalmia, is in the tunica conjunctiva.

The Cornea.

The transparent membrane, which fills up the vacuity in the anterior part of the sclerotica, is denominated *Cornea;* from its resemblance to horn. It is said to be superior in strength to the sclerotica; and it is also very firm. It is formed of lamina, that are separable from each other; which are supposed to be connected by a very delicate cellular membrane.

This cellular membrane appears sometimes to contain a fluid; for if a section be made of the coats of the eye, and pressure be applied to the cornea, an exudation will be perceived, both upon its internal and external surfaces.

The cornea is covered by the tunica conjunctiva; which adheres firmly to it, but may be separated after maceration. It can also be separated from the sclerotica after maceration, and a slight degree of putrefaction; especially if the parts, when in this situation, are suspended a short time in boiling water.

The cornea is lined internally by a fine membrane, called the *Capsule* of the aqueous humour; which will be evident if the coats of the eye are boiled. In this case, the cornea hardens; and the capsule of the aqueous humour appears detached from it, like the cuticle raised by vesication.

In a sound state, the sensibility of the cornea varies considerably.* The vessels in its structure do not carry red blood: it is however much changed

* It is the opinion of Dr. Physick, whose numerous and successful operations on the eye have afforded him many opportunities of judging, that the incision of the cornea always occasions some pain; which is very different, as to its intensity, in different persons.

in its structure by inflammation; and it is said that blood has been found between its lamina, in consequence of violent strokes upon the eye.

It is the segment of a smaller sphere than the sclerotica; and therefore is more convex. The degree of convexity is very different in different persons; those in whom it is very great are necessarily short-sighted. It is not perfectly circular, but rather oval: the transverse diameter being the longest.

The cornea and sclerotica are connected to each other by sloping surfaces. The edge of the sclerotica projects over the internal lamen of the cornea; and the edge of the cornea passes under the external surface of the sclerotica.

The separation above mentioned proves the cornea and sclerotica to be distinct from each other. And although their structure is essentially different in the human species, it is much more so in some fishes and in some birds.

From what has been already stated, it appears that there are pores in the cornea, through which the fluid situated between its lamina may be pressed. It is probable that an exudation through these pores takes place after death; as a pellicle then forms on the cornea; which, upon examination, appears to originate from the drying of a fluid effused there. This has been considered as a proof of death; but there are few practical physicians who have not seen a similar pellicle, during life, in persons who were very weak.

The Choroid Coat.

The sclerotica and cornea compose a firm external shell for the eye; upon which its form depends.

The sclerotica is lined by a thin, flexible, very vascular membrane, denominated *Choroides;* which is in contact with it nearly throughout its whole extent.

The choroides has been supposed to be derived from the pia mater; but this sentiment is not confirmed by observation: for the pia mater appears to be connected with the interior surface of the sclerotic coat.

It is so delicate a membrane, and so vascular, that it has been considered by some anatomists as a texture composed entirely of vessels and nerves.

It has three sets of arteries, which are derived from the ophthalmic branch of the internal carotid, viz.

1st. *The long ciliary arteries*, which are generally two in number: they penetrate the sclerotic coat at the posterior part of the eye, and pass, one on each side of the external surface of the choroides, dividing at the ciliary circle, each into two branches, which inosculate with each other around the great circumference of the iris.

2nd. *The short ciliary arteries*, which are very numerous: they penetrate the sclerotic coat near the optic nerve: are spread upon the choroides, and anastomose very frequently with each other: in their progress forwards they penetrate from the external to the internal surface of the choroides, and supply the iris and ciliary processes.

3d. *The anterior ciliary arteries*, which are not very numerous; and penetrate the sclerotic coat no great way behind the cornea. These are distributed among the branches of the long ciliary arteries on the iris.

The veins of the choroides are very peculiar: besides those, which accompany the arteries above described, there are several veins which are situated more internally than the arteries and nerves, and about the middle of the eye: their branches are not arranged in the usual manner, but run from the main trunk, nearly in a semicircular curve, are almost parallel to each other, and very numerous; from

this arrangement of their branches they are called the *Vasa Vorticosa.*

The nerves which appear on the choroides, come from the ophthalmic ganglion: they pass very obliquely through the sclerotica, and run forwards; having a very flat appearance in proportion to their size: five or six of them are of this description; some others are very small.

The internal surface of this coat is covered with a black paste, denominated *Pigmentum Nigrum.* This appears to be spread most thickly on the anterior part of it, and thinner behind, near the optic nerve: it is said to be thinner and less dark in old persons. It seems to resemble the matter of the rete mucosum of negroes, when that is softened by putrefaction. It is asserted that the colour of this pigment has never been changed by the ordinary chemical agents, or by moderate heat. When it is washed away, the internal surface of the choroides appears to be villous.

There is also a portion of this substance on the external surface of the choroides. It is said that in very recent subjects, this matter appears to be inherent in the structure of the internal surface, and does not come off when it is rubbed gently; or even when immersed in water; but it is certain, that a considerable quantity of it sometimes appears on the exterior surface of the choroides, in eyes that are not very recent.

The celebrated Ruysch, and many anatomists after him, have considered the choroides as composed of two lamina; but it seems to be the opinion of the anatomists of the present day, that it consists of but one membrane; and there are some who consider it as a mere tissue of vessels.

In the white rabbit, and some other animals, the pigmentum nigrum is entirely deficient: and the pu-

pil of the eye appears of a red colour, owing to the blood vessels of the choroides.

The general connexion between the choroides and sclerotica is very slight; depending upon a fine cellular substance, and very small blood vessels and nerves.

But immediately around the margin of the cornea, the choroides and sclerotica are firmly connected to each other, by the intervention of a portion of cellular substance, which, although soft, is dense and compact, and of some thickness. As this substance extends round the circumference of the cornea, it necessarily forms a ring; which is between one and two lines broad. This substance, thus placed, constitutes the *Ciliary ligament;* which has, to the great perplexity of students, been called by many different names; as *Orbiculas Ciliaris*, *Annulus gangliformis*, *&c.**

It is very distinguishable from the choroides, the sclerotica, and the iris; and appears generally of a gray colour; but contains the ciliary nerves and arteries, in great numbers, as they pass to the iris.

In this circular band is a small canal, discovered by the Abbe Fontana, which is moistened by a pellucid fluid; but its use is not known.†

All the choroides, which is posterior to the ciliary ligament, is in close contact with the internal surface of the sclerotica; but the choroides continues anterior to the ligament; and this anterior portion takes a different position. It no longer lines the internal surface of the shell of the eye; but is reflected inwards; and takes a transverse direction, as if it were to form a partition. This reflected part forms the *ciliary body*, and the *ciliary processes*, which will soon be described.

* Discovered by Fallopius, in 1584.

† See Fontana on the poison of the viper, vol. 2, page 310: and also Adolph Murray, Nova Acta Upsal, vol. 3.

The choroides begins to take this reflection inwards, at the place where it is connected with the ciliary ligament. Immediately anterior to the ligament, the cornea is continued from the sclerotica; and being more convex than the scletorica, it projects externally and anteriorly. As the ciliary ligament is situated between the sclerotica and choroides, very near to the place where the sclerotica unites to the cornea, and where the choroides is reflected internally to form the ciliary processes, the edge of the ciliary ligament must lie in the angle formed by the cornea, which is anterior and external, and the reflection of the choroides, which is internal. To this edge of the ciliary ligament is fixed the circumference of the circular membrane, called *Iris*, which is now to be described.

The Iris

Is a flat membrane, which does not partake of the spherical figure of the sclerotica and cornea, or of the choroides; but extends across a portion of the cavity of the eye, and forms a septum. As it is circumscribed by the ciliary ligament, it is necessarily circular. It has a round foramen near its centre, which is called the *Pupil;* which, in the healthy subject, varies continually in size, according to the degree of light to which the eye is exposed.

The situation of the iris, in the cavity of the eye, is such that, at its circumference, it is nearly in contact with the circumference of the cornea: it is actually in contact with the anterior edge of the ciliary ligament, and with the anterior surface of that part of the tunica choroides, which is reflected inwards and forms the ciliary processes.

As the iris is flat or plane, and the cornea is the segment of a sphere, there must be a considerable vacuity between them. This vacuity constitutes the anterior chamber of the eye.

The iris therefore is a septum, passing across the eye at its anterior part; and separating that portion of the cavity, which is bounded exteriorly by the cornea, from the larger portion formed by the sclerotica.

The anterior, or external surface of this membrane, is very remarkable for its colour: in persons of a light complexion it is generally of a light blue intermixed with white: or of a gray, or light hazel, &c. In those whose complexions are dark, it is almost invariably dark also. These colours are so arranged, that frequently there is an appearance of lines, sometimes nearly radiated, more frequently curved in various directions, but tending from the circumference towards the pupil or centre; and when the general colour of the iris is blue, these lines are often whitish.

When this surface is examined in water with a magnifying glass, it appears to be covered with very fine villi; which probably have the effect of increasing its lustre.

From a supposed resemblance of these colours to those of the rainbow, this membrane has been called *Iris;* and is generally known by this name: but unfortunately another appellation has been given to its internal and posterior surface, which is covered with a black pigment like the choroides, and has been commonly called *Uvea.*

This black pigment, on the internal or posterior surface of the iris, has been supposed to have a great effect in determining its general colour: and there is some reason for this opinion, as the iris is partly transparent; but there is a colour inherent in it, which is most evident when the black pigment is very carefully washed away.

Thus, the light hazel colour remains unchanged after the black pigment is removed; and it is not

probable that light blue is much influenced by the black pigment.

The iris is capable of dilatation and contraction to a very considerable degree; by which the pupil, or central vacuity, is enlarged or diminished. By this means it regulates the quantity of light admitted into the eye. Upon the first exposure to strong light, the pupil of every healthy person is observed to be diminished; and, upon the diminution of light to be enlarged.

It has been ascertained by experiment, that this motion of the iris is not excited by the action of light immediately upon it, but on the interior surface of the eye; and this circumstance has occasioned the greatest attention to the structure of this extraordinary and important membrane.

Anatomists of the greatest respectability hold opinions extremely different indeed, respecting the structure of the iris. They agree that there are many radiated fibres on the posterior surface, commencing at its circumference, which can be readily seen when the black pigment is washed away; but while many respectable anatomists declare that they have not been able to see any circular fibres, Dr. Monroe describes them minutely; and has published a plate of them. He considers them as forming a circle immediately round the pupil; which circle makes about one-fifth part of the breadth of the iris.*

In the human subject, the iris does not appear to be divisible into lamina. It is abundantly supplied with arteries, which form two circles upon it: and it has also a large supply of nerves.

The operations of the iris, in contracting the pupil, upon exposure to light, and dilating it, when

* See his publication, entitled Three Treatises: On the Brain, the Eye, and the Ear.

light is diminished or withdrawn, have been explained very differently by persons who have different sentiments respecting its structure. Some of those persons, who do not believe in the existence of muscular fibres in the iris, suppose its motions to depend upon the sudden turgescence or depletion of its blood vessels: while others impute it to a peculiar quality, exclusively enjoyed by this membrane.

Dr. Monro, who refers the contraction of the pupil to the action of the circular fibres, which is excited by the stimulus of light applied to the retina, considers this operation as analogous to that of the abdominal muscles, in those cases of coughing, which are produced by irritation of the glottis. The action of the muscles, in these instances, being excited by substances applied to the glottis, which would have produced no irritation if they had been applied to the muscles themselves.

The dilatation of the pupil appears, in the human species, if not in other animals, to depend upon a different cause. It seems to be a passive state of the eye, which takes place when the stimulus is withdrawn, and the consequent action ceases. There is some elasticity in the iris; and a great many, perhaps all, of its *natural or healthy* motions in the *human species*, may be explained by the contraction of the circular fibres, induced by irritation: and by the contraction of the rest of the membrane in consequence of its elasticity; which always exhibits its effects when the muscular action ceases.

The elastic power in this case may have some analogy to the elasticity of the arteries, which certainly produces some of the contraction of those vessels; but there is another principle of contraction superadded to this, which produces effects different from those of mere elasticity.

In the fœtus, prior to the seventh month after con-

ception, the pupil is closed by a delicate vascular membrane, called the *Membrana Pupillaris;* which, after this period, completely disappears.*

The iris was formerly supposed to be a continuation of the choroid coat; but it is now generally agreed that it is a distinct membrane; for when the eye is very slightly affected by putrefaction, it can be pulled off and the choroides left entire.

The choroides, on the contrary, cannot be sepa- from the ciliary processes without laceration; and when the pigment is washed away from its internal surface, it is very obvious that these processes are continued from the substance of the choroides and reflected inwards, so as to form a projection into the cavity of the eye.

Of the Ciliary Body, and the Ciliary Processes.

This internal projection forms a ring or a circle, which has the ciliary ligament before described, near its circumference, and anterior to it.

It is so disposed, that the whole of its internal or posterior surface appears to be formed into radiated plaits, which extend from the circumference to the central vacuity, where they terminate.

The whole of this structure, or the membrane thus plaited, is called the *ciliary body*, while the plaits are called the *ciliary processes.*

In a natural state of the eye, the ciliary body is covered with a large portion of the pigmentum nigrum. It may be seen very well by placing the eye on the cornea and removing the posterior part of all the coats, without deranging the humours. When thus viewed from behind, it has a black surface, and appears like a ring formed of radiated lines;

* The discovery of the Membrana Pupillaris is claimed by Wachendorf, Prof. of Botany in the University of Utrecht; by John Hunter; by Haller; and by Albinus.

it has been compared to a flower with radiated petals.

When the black paint is washed off, and the humours of the eye removed with proper caution, the plaited structure of these radiated processes will be very apparent; it then will appear that the membrane of the choroides is so arranged as to form radiated plates, and that these plaits are the *ciliary processes*.

These plaits or processes do not lie upon each other, but are placed on their edges, one edge looking into the cavity of the eye, and the other edge anteriorly towards the iris.

Each *ciliary process* seems to originate from two lines or smaller plaits, called the *ciliary striæ*, which soon unite and form it. *The process* or plait, thus formed is rather larger at its central extremity than at any other part: and their central extremities are not of equal lengths, but alternately longer and shorter.

The ciliary processes do not extend to the centre of the circle of which they are radii, but stop short of it; and thus include a circular vacuity or aperture, which is larger than the pupil of the iris, and situated a little way within or behind it. This aperture is occupied by the crystalline lens (to be hereafter described;) but the central extremities or terminations of the ciliary processes do not adhere to the lens, for they are loose and moveable; but they are in contact with its anterior surface, near the margin.

It is however to be observed that the ciliary processes are loose only at their central extremities: for, towards their other extremities, they seem to adhere, anteriorly, to the iris: and posteriorly, to the retina, and to the capsule of the vitreous humour.

The ciliary body, (or the radiated ring formed by

all the processes) is about two lines broad in the *human subject:* but the part next to the nose is rather narrower than the rest of it.

The black pigment is spread over the whole of the posterior, or internal surface, of the ciliary body; but it is much more abundant towards the circumference than towards the centre. It is also more abundant in the furrows between the ciliary processes than it is in the processes themselves: and as the membrane, of which the processes or plaits are formed, is of a whitish colour, the processes, at their central extremities, have a whitish cast.

The black pigment is also spread over the anterior surfaces of the processes; on all that part which is loose, and not in contact with the posterior surface of the iris,

When the pigment is completely washed away, the colour of the ciliary body appears grayish; but if the eye has been successfully injected, it will appear to be composed almost entirely of vessels; and to have a villous surface.

The Retina.

Within the tunica choroides, and in contact with its internal surface, is a third coat of the eye: the *Retina.* This coat is evidently derived from the optic nerve, although its texture appears somewhat different.

Before the optic nerve arrives at the ball of the eye, a small branch of the ophthalmic artery penetrates its coats; and when the nerve perforates the tunica sclerotica, as described in page 352, this artery passes with it.

On the internal surface of the choroides, the nerve forms a small prominence: and from this, the retina expands, with many ramifications of the aforesaid artery in it.

The retina has the appearance of mucus, and the semi-transparency of a surface of ground glass; but when immersed in water, it floats like a membrane.

By particular management, when the retina floats in water, a considerable quantity of the soft substance may be removed; and a delicate, soft, transparent membranous substance, with the vessels, will remain.

The retina, therefore, seems to consist of a delicate, vascular, membranous web, with a medullary pulpy matter spread upon it, and supported by it.

Thus constituted, the retina extends from its origin, at the optic nerve, to the commencement of the ciliary processes.

It lines the choroid coat, and is therefore in contact with the pigmentum nigrum, on its internal surface; but it is simply in contact with it, and is not tinged by it. No vessels pass from it to the choroides; and when a posterior section of the eye is made, it slips from it without any appearance of adhesion; being attached only to the optic nerve.

Most anatomists agree respecting these circumstances; but there is the greatest difference of opinion respecting the extent of the retina. Several distinguished anatomists, of the century lately past, thought very differently from each other on this subject: and two of the first anatomists of the present day have embraced opinions entirely opposite. Monro is convinced that it extends, under the ciliary processes, to the crystalline lens: and Soemmering asserts positively, that it terminates at the commencement of the ciliary processes. Some of the* anatomists of London incline to the opinion embraced by Soemmering: and the late ingenious Bichat adopted the opinion embraced by Monro.

* See the new Cyclopedia, by Dr. Rees and others; article Eye.

Both parties confide in their own observations, and refer to the eye. An object which appears so very different to different persons, who have good sight, cannot be very distinct. The pulpy substance of the retina appears to terminate at the commencement of the ciliary processes; but a membrane, of a very different texture, seems continued from it to the crystalline lens.

Although the eye and the retina have long been objects of anatomical attention, professor Soemmering made an interesting discovery respecting it, so lately as the year 1791, viz. that at the posterior part of the retina, in the axis of the eye, and of course a little exterior to the entrance of the optic nerve, there is a spot of a circular or oval figure, about one line, or rather more, in diameter, of a yellowish or saffron colour, which is brightest about the centre.

In the centre of this spot is a round hole, equal, in diameter, to one-fourth of the spot. There are generally several small plaits of the retina about this place: one of these, which is very constant, extends from the optic nerve to this spot.

The colour of this spot is pale in children, bright in young persons of mature age, and pale at an advanced period of life.

The foramen is to be found in the fœtus, but not the yellow spot. The colour of the spot diminishes when vision is obstructed; and the spot disappears when vision is lost.

There is the greatest reason to believe that the retina is the seat of vision: but it has been ascertained, most decisively, that the extremity of the optic nerve, from which the retina originates, is insensible to the rays of light.

[Within three or four years a membrane has been discovered by Mr. Jacobs, Demonstrator of Anatomy

in Trinity College, Dublin, which is situated between the retina and the tunica choroidea. Its tenuity and delicacy are extreme. It is diaphanous and is thought by its discoverer to be a serous membrane. It extends from the optic nerve as far forwards as the retina goes, and adheres by a delicate filamentous structure to both the retina and the choroid coat, but much more firmly to the former. Mr. Jacobs asserts that this filamentous structure, by which it adheres to the other two coats, is vascular: as this assertion however is founded on a process of reasoning, and not on absolute demonstration, our assent may very properly be withheld from it till an injection is brought forward to prove the fact. This membrane is well marked also in the sheep, ox, horse, dog, and other domestic animals, indeed in all the mammalia which he has had the opportunity of examining. It exists also in birds and fishes, and is said to be particularly strong in the latter. Mr. Cuvier has described it in fish as one of the lamina of the retina, but its sensible properties are asserted by Mr. Jacobs to be very dissimilar from those of the retina.

As this membrane may possibly be confounded by the student with one of the lamina of the human retina, it should be borne in mind that the latter consists of two parts, a pulpy or nervous expansion and a reticulated vascular structure on which the pulp is laid, the pulpy part being exernal.

The reticulated structure is called by some the tunica vasculosa retinæ. Most anatomists have known and admitted these two membranes as composing the retina, yet but few have had the expertness to separate them from each other, and to leave at the same time the membranous structure visible. Albinus had the success to accomplish this separation, and

I am informed, on the authority of Dr. Physick, that Mr. Hunter also succeeded in it.

When the common dissection of the retina is made and fixed in clear water, this membrane will be seen floating around it in delicate flocculi; but if a more careful dissection be made, by fixing the eye to the bottom of a basin of water, by its cornea, through the aid of shoemaker's wax, and the sclerotica and choroidea be removed from behind, this membrane may be turned down entire from the retina, with the end of the handle of a scalpel.] Ed.

SECTION III.

Of the Humours of the Eye.

The three humours of the eye, viz. the *Aqueous*, the *Crystalline*, and the *Vitreous*, are separately invested with a membranous capsule; which is very delicate, and perfectly transparent.

The Vitreous Humour

Occupies almost all the cavity of the eye which is posterior to the iris. It of course possesses a spherical form. It has a depression in the centre of its anterior surface, in which the posterior surface of the crystalline lens is received. It is covered by the retina as far as the retina extends.

The peculiar consistence of this body, which resembles that of melted glass, is owing to its membrane; which is a spherical sac, divided by many septa, or partitions, that form small irregular cavities, in which a fluid is contained. This membranous sac is most perfectly transparent, and very flexible; it has, however, some strength; as it will support the weight of all the fluid it contains; and may be suspended from a hook or forceps. The fluid may be separated from the membranes, by

beating the vitreous humour in a cup with a spoon; or by suspending the vitreous humour, and then puncturing it. In either case the fluid escapes; but the internal arrangement of the membranes is not visible.

It is said that when this body is frozen, the portions of fluid in the different cavities, have sometimes been distinguishable from each other, as distinct pieces of ice; and that their form is that of small wedges; with their edges directed to the crystalline lens as a centre, and their bases to the circumference of the vitreous humour. It is also said, that if this body be immersed in a solution of potash, the membranes will become opaque, while the fluid continues transparent: and that the appearance of the cells, thus exhibited, agrees with the form of the pieces of ice above mentioned.

This membrane is now generally called the *Tunica Hyaloidea*, from two Greek words which imply a resemblance to glass.*

Its particular structure is not perfectly understood. Vessels are not generally seen on it in the adult; but, in the fœtus, the artery in the optic nerve, (or the central artery,) sends a branch through the vitreous humour to the crystalline lens: and some branches of this artery are to be seen on the tunica hyaloidea.

Throughout the greatest part of its extent it appears to consist of but one lamen; but at the front part, near the ciliary processes, there are two lamina. The internal, or posterior, seems to be a portion of the proper tunica hyaloidea, and passes behind the crystalline lens. The external, or anterior, passes over and before the lens; or at least is attached to the anterior part of the capsule, in which the lens

* Discovered by Fallopius in 1584.

is contained. It is supposed by some anatomists, that this membrane is continued completely over the crystalline lens; but it has not been separated.

As this lamen extends round the crystalline lens, it is in contact with the ciliary processes; or with a production from the retina, which is supposed by some anatomists to pass between them. It is impressed with radiated plates by the ciliary processes, and some of the pigmentum nigrum of these processes adheres to it.

As these lamina of the tunica hyaloidea are separated by the crystalline lens, there is a vacuity between them, around the margin of the lens: and this vacuity must necessarily be circular in its course.

It is not probable that any considerable quantity of fluid is contained in this vacuity; for the two lamina concerned in its formation, appear in contact with each other. It can be readily demonstrated by puncturing the external lamen, and blowing into it through a small pipe. When thus distended, there appear to be incomplete partitions in the canal; or partial adhesions of the lamina forming it, which have the effect of partitions; these partitions are placed in a radiated direction, at some distance from each other, and give the canal a peculiar indented appearance. It is called by the name of the celebrated Petit who discovered it.

The anterior lamen of the tunica hyaloidea, which forms part of this canal, seems to adhere to the coats of the ciliary processes; for if a section is made behind the ciliary ligament of all the coats of the eye, the vitreous humour will be found adhering to the anterior portion of the section, when it is lifted up.

When the fluid contained in the tunica hyaloidea is discharged and collected, it appears to resemble, in all its properties, the fluid in the anterior chamber of the eye; which. from its consistence, has been

called the *Aqueous Humour.* This circumstance proves that the particular consistence of the vitreous humour is derived from the arrangement of its internal membranes.

The fluid, thus obtained, consists of water slightly impregnated; 1st, with albumen, 2d, with gelatine, and 3d, with muriate of soda.

The vitreous humour appears necessary, to give the ball of the eye the necessary size, for the performance of its optical functions: to keep the retina properly distended: and to retain the crystalline lens at the proper focal distance from the retina.

The Crystalline Lens

Is a solid body; although it is considered as one of the humours of the eye. It is of a softish consistence: and has been compared to gum half dissolved; but is more firm in the centre than about the circumference.

When sound it is perfectly transparent in young and middle aged persons; but is yellowish in old age. It is convex on both surfaces, but the convexity of the different surfaces, is different. The anterior surface, which is the least convex, is the segment of a sphere, whose diameter varies from six to nine lines. The posterior surface, which is most convex, is the segment of a sphere, whose diameter varies from four lines and a half, to five lines and a half. This lens is most convex in young subjects.

It is invested with a tunic of the same lenticular form with itself; which has some firmness; but in a healthy state, is also perfectly transparent. The lens either does not adhere at all to this tunic, or so slightly, that it projects from it with very slight pressure, as in the operation of extracting the cataract.

The posterior surface of this tunic adheres firmly

to the tunica hyaloidea, with which it is in contact: and this last membrane, is generally ruptured in the attempt to separate them, although the separation can sometimes be effected without rupture.

The anterior surface is so intimately connected with that lamen of the hyaloid tunic which passes before it from the canal of Petit, that it is not separable without laceration; and it therefore has not been ascertained whether this lamen extends completely over the surface.

As the capsule of the lens is thus connected with the tunica hyaloidea, and this last mentioned tunic adheres to the ciliary body, it necessarily follows that the lens is confined in its proper position behind the pupil.

Notwithstanding the soft consistence of the exterior portion of the lens, there is reason to believe that it has a peculiar organization; for if it be immersed some time in a diluted solution of the nitrate or muriate of alumine, or in several other fluids, and then dried, it will be found to be composed of concentric lamellæ, which resemble those of the bulbous roots; and these lamellæ will appear to consist of fibres.

It has been supposed that muscular fibres entered into the composition of the crystalline lens, but this opinion has never been generally adopted.*

Between the lens and its capsule a small quantity of a transparent fluid is sometimes found, which escapes whenever the capsule is punctured. This fluid is supposed to be most abundant on the anterior surface, and is called Liquor Morgagni.

The lens is said by chemists to be composed of albumen and gelatine, with some phosphate of lime;

* See Dr. Young's Memoir in the Philosophical Transactions for 1793.

and it is asserted that the proportion of gelatine is much smaller in the centre than in the exterior parts.

No blood vessels are to be seen in any of the humours of the eye, or their capsules, excepting those of the fœtus. In the fœtus a branch can be traced from the central artery of the retina, through the vitreous humour, to the posterior surface of the crystalline capsule, on which it ramifies. In similar subjects vessels have been seen passing from the ciliary processes to the anterior surface of the capsule; and it is also asserted by very respectable anatomists that they have seen vessels passing from the capsule into the substance of the lens.

The *use of the crystalline lens* is to concentrate the rays of light, so as to form a distinct image at the bottom of the eye.

The Aqueous Humour

Occupies the space which is between the crystalline lens and central extremities of the ciliary processes and the cornea. This space is divided by the iris into two chambers, very dissimilar in figure, which communicate with each other by means of the pupil. The posterior chamber is much smaller than the anterior, and its existence has been doubted; but it is easily proved by freezing the eye, when it is found filled with a part of the aqueous humour in a state of congelation.

The *aqueous humour*, in a natural state, is perfectly transparent; but in the fœtus, and for a short time after birth, it is reddish and turbid. It consists of water impregnated with albumen, gelatine, and muriate of soda; and of course resembles the fluid of the vitreous humour.

It is probable that this fluid has also a capsule appropriated to it; for, after boiling an eye, a delicate membrane can be found lining the internal sur-

face of the cornea, and extending from it over the anterior surface of the iris. It has not yet been traced as far as the pupil, but it is probable that it extends through the pupil, and lines the posterior chamber also.*

The aqueous humour is quickly renewed after it has escaped in consequence of wounds or operations, and blood accidentally effused into its cavity is often absorbed.†

This fluid preserves the convexity of the cornea, and admits the free motions of the iris; allowing at the same time a ready passage to the rays of light.

It will be very beneficial to every student of anatomy to dissect this delicate organ himself, as he will thereby acquire more accurate and precise ideas of its structure than he can possibly obtain from the ordinary demonstrations.

The eyes of sheep and oxen will serve very well for beginners, as many of them will be required, and they can be easily obtained. They resemble the human eye in many respects: and the circumstances in which they differ may be readily ascertained by the diligent student; especially if he dissects the human eye afterwards.

For this purpose it will be requisite to have forceps, finely pointed; with knives and scissors that are equally delicate in structure; and also a pair of strong scissors, bent like those in the cases of pocket instruments.

When removing the exterior parts, it will be useful to preserve a portion of the optic nerve, to take hold of.

The dissection of the coats of the eye can be best performed when the eye is placed in a vessel of water; which should be shallow or deep, according to the different stages of dissection.

* This capsule was discovered by Messrs. Demours and Descomet, who disputed each others claim in 1767. It is thought to be useful in preventing the cornea from being penetrated by the aqueous humours, and the pigmentum nigrum from being washed off the iris, and making this humour turbid. Mr. J. Cloquet says that he has traced it in the posterior chamber of the eye. From his account it appears that there is one capsule in early fœtal life for the anterior chamber, and another for the posterior chamber, and that the Membrana Pupillaris is formed by these capsules being stretched across the pupil, back to back. Ed.

† The aqueous humour, according to Mr. Hunter, can be coagulated with Goulard's Extract. Ed.

In some dissections it will be serviceable to form a bed of jelly, to support the eye, as proposed by Mr. C. Bell.

As the first process in this operation, the sclerotic coat can be readily separated from the choroides, and the cornea with it.

After examining the external surface of the choroides, the ciliary ligament, and the iris, the iris may be peeled off from the choroides.

The choroides, by a careful process, may then be separated from the retina, which it leaves surrounding the vitreous humour. The ciliary processes, being a part of choroides, come away with it.

The preparation being in water, may now be suspended by the optic nerve. It consists of the vitreous and crystalline humours and the retina. The retina, originating from the optic nerve, adheres anteriorly also, with so much firmness that it will support the part inclosed.

The retina may be removed without lacerating the tunics of either of the humours; and the pigmentum nigrum, which often adheres to that part of the vitreous humour which was connected with the ciliary processes, may be washed away with a piece of soft sponge. By this washing the radiated grooves in the vitreous humour, which were connected with the ciliary processes, will be very apparent.

To examine the iris in its natural situation, an aperture may be made in the cornea of a fresh eye near its circumference, and the cornea cut out with the strong scissors. This exposes the anterior surface of the iris.

The iris may then be easily removed, and the crystalline lens, with the central extremities of the ciliary processes surrounding it, will be exposed to view.

To examine the ciliary processes on the other side, a lancet may be plunged into another eye, somewhat anterior to the middle, and the eye divided by means of the strong scissors. The anterior section should then be laid on the cornea, and the ciliary process will appear very distinctly, seen through a portion of the vitreous humour. The retina may also be seen at the same time, and a judgment may be formed of its extent. The view will be more distinct, if part of the vitreous humour should be cut away with the scissors and forceps, so as to lessen the quantity without deranging the parts under it.

Several methods have been proposed for rendering the structure of the vitreous humour, and the processes of the tunica hyaloidea, more distinct. None of them have been very successful: but if the vitreous humour be suspended in water by means of a thread passed through that part which surrounds the crystalline lens, and some large incision be made

into the most depending part of it, after some days of suspension, its bulk will be diminished, by the discharge of the fluid. If, in this situation, it be immersed in a solution of nitrate of silver, the tunica hyaloidea will become very apparent; and by various degrees of exposure to light, may have its colour varied from a whitish opacity to a dark brown.

The appearance of the retina is also much changed by immersion in the solution of nitrate of silver. This effect of the solution, at first sight, appeared calculated to decide the question respecting the extent of the retina; but after several applications it could only be said, that the pulpy substance of the retina appeared to terminate at the commencement of the ciliary processes, while a membrane of a different texture seemed continued from it to the crystalline lens.

CHAPTER IV.

OF THE EAR.

The organ of hearing is composed of three distinct parts, viz. 1. The exterior portion, which, although merely auxiliary, is denominated the *External Ear*. 2. A chamber, situated in the petrous portion of the temporal bone, which is called the *Cavity of the Tympanum*. 3. A deeper seated cavity in the same bone, which, from its complicated form, is denominated the *Labyrinth*.

SECTION I.

Of the External Ear.

The *External ear* consists of the expanded portion, exterior to the head, commonly called the *Ear*: and a wide tube passing from it to the cavity of the tympanum, called *Meatus Auditorius Externus*.

The form of the *Ear* is so familiar to every one that it is not necessary to describe it. The uppermost and longest portion is denominated *Pinna*. The small pendulous part below is called *Lobus*.

The form, as well as the firmness of the *pinna*, depends entirely upon a cartilage: the *lobus* consists of skin and cellular membrane.

The skin which covers the pinna is particularly delicate; and when the cuticle is separated from it by maceration, it appears to be perforated with an unusual number of foramina, which are the orifices of the sebaceous glands. It is connected to the subjacent cartilage by a dense cellular membrane, which, in most places, is free from adeps.

The cellular membrane of the lobus contains adeps very delicately arranged.

The circumference of the ear is formed by a fold of the margin of the cartilage: and this folded edge is denominated *Helix,* from its winding direction. It commences in the cavity called *Concha,* to be presently described: and after proceeding forwards and upwards, it turns round backwards and downwards.

Within this prominent margin is a second prominence, called the *Antihelix,* which appears to be formed by a convexity of the surface of the cartilage, but is found in every ear. It is nearly semicircular, with its concavity towards the meatus; and it forms the margin of the cavity called *Concha,* above mentioned. The upper portion of the antihelix consists of two superficial ridges which unite after forming between them a shallow depression, the *Fossa Navicularis,* or *Scapha.*

The helix and antihelix form therefore three cavities or depressions, viz. 1. A sulcus, occasioned by the fold of the helix, which is sometimes called *Fossa innominata.* 2. The *Fossa Navicularis:* and 3. The *Concha,* which may be considered as the proper orifice of the ear.

Besides these prominences and fossæ there are two other eminences, called *Tragus* and *Antitragus,* formed also by this cartilage. The *Tragus* is anterior to the meatus auditorius, and covered by a continuation of the skin of the face. It projects backwards, so as partly to cover the meatus. On the inside of it there is commonly a tuft of hair, from which its name is derived.

The *Antitragus* is opposite to the tragus, on the posterior margin of the concha.

On the posterior surface of the ear the convexity of the concha is very conspicuous.

When the skin and cellular membrane is carefully removed, and the cartilaginous skeleton of this structure is examined, its form will not appear so

regular as that of the undissected ear; for there are several deficiences or vacuities in it; the most remarkable of which is between the tragus and the helix.

The cartilage thus formed, is attached to the bones of the face and cranium, by three ligamentous membranes, which connect it to the zygomatic and the mastoid processes of the temporal bone, and to the aponeurosis on the squamous portion of the same bone.

In addition to the common muscles of the ear, described at page 175, there are a few muscular fibres, which, *in some subjects*, may be discerned on particular parts of the cartilage, and therefore are considered as muscles proper to these portions of the ear.

There are five of these portions of fibres: two on the helix, one on the tragus, one near the antitragus, and the fifth on the other side of the ear.

The *Major Helicis* is on the anterior and most prominent part of the helix above the tragus. The *Minor Helicis* is lower down on the helix, in the concha.

The *Tragicus* lies on the tragus, and the *Antitragicus* behind the antitragus, while the *Transversus Auris* is on the other side of the ear, on the prominence formed by the concha near its circumference.

It may be observed respecting the muscles of the ear, that even the common muscles, which are by far the largest, are unable, in many persons, to move that organ; and the proper muscles, in a large majority of mankind, cannot be perceived to produce any effect at all.

There are difficulties in explaining the form of the cartilage; for, notwithstanding the well known opinion of the Geometrician said to have been employed by Boerhaave, that the line of reverberation is directed to the meatus auditorius externus from every

part of the ear; in many persons the cartilage is so situated, that the concha appears to be the principal, if not the only part, from which sound can be reverberated into the meatus.

It may be questioned whether the backward position of the ear, which is commonly observed at the present day, is altogether natural; as a more prominent position seems much better calculated for the reverberation of sound; but this position of the cartilage is observable in many infants at birth.

It is asserted by some comparative anatomists that the cartilage is stronger and more elastic in proportion to its size, in man, than in any other animal; and that the lobus is peculiar to the human ear.

The *Meatus Auditorius Externus* is a tube, extending from the concha to the membrana tympani; the external extremity of which is principally composed of cartilage, and the internal of bone. The cartilage in the external portion of the tube is a continuation of the substance of the concha. It does not solely form a complete tube, for when the meatus is opened longitudinally and spread out, this cartilage appears triangular in shape; a fibrous membrane being joined to it to complete the tube.

In addition to the deficiency thus arising, there are two others, one of which, that has a transverse position, is of considerable size. These deficiencies are called *Incisuræ;* and the fibrous structure which closes that which is transverse, has been called by Santorini, who described it, *Musculus Incisuræ Majoris.*

The cartilage is attached to the bony portion of the meatus at the lower part of its margin, and forms about one half of the length of the meatus.

The skin covering the external ear is continued into the meatus, and lines it throughout: extending over the incisuræ, and also over the membrana tym-

pani. It adheres more firmly to the periosteum of the bony part of the meatus than to any other portion of the canal. Some fine hair is often observable growing out of it at the external extremity. As the skin advances deeper in the meatus it becomes more and more delicate and sensible. The extreme pain excited by the penetration of an insect, or the introduction of an instrument, into the ear, evinces the great degree of sensibility with which it is indued.

Exterior to the skin, in the cellular membrane which surrounds it, are many small glands* of a yellowish colour, whose ducts open upon the surface of the meatus, and pour upon it the substance called *cerumen* or ear wax. These glands are most numerous about the middle of the meatus, and at those places in which the cartilage is deficient. The cerumen is fluid at first, and gradually thickens. In some diseases of the meatus it has the appearance of pus.—The use of this secretion is probably to exclude insects, for which it is well calculated by its tenacity and bitterness; and also to defend the delicate surface upon which it is spread.

The direction of the meatus is inwards and forwards: it is also curved, with the convexity upwards; but it is very easy, by management of the external ear, to admit the rays of the sun to the bottom of the meatus, and bring the membrana tympani into view.

A vertical section of the meatus is of the oval figure. In the fœtus the bony part of this duct is not formed, and the meatus consists entirely of cartilage.

* Discovered by Stenon, in 1662.—Ed.

SECTION II.

Of the Cavity of the Tympanum.

The meatus auditorius externus is terminated abruptly by the membrana tympani, which forms a septum that closes it completely.

On the inner side of this septum is the *Cavity of the Tympanum*, which may be regarded as the continuation of the *bony meatus.*

It differs however from the form of this canal, for its diameter is greater, and it is not so regularly cylindrical.

It is not deep, as the distance from the membrana tympani, which constitutes the external side, to the opposite internal side, is seldom more than three or four lines.

The breadth of the cavity of the tympanum is therefore greater than its depth.

It is situated immediately between the membrana tympani, and the labyrinth, which is on the inside of it.

In its natural state this cavity has two apertures: one which communicates with the fauces, by means of the *Eustachian Tube;* and another which leads into the cellular structure of the mastoid process.

There are also two deficiencies in the bony plate, which separates it from the labyrinth, called the *Foramen Ovale,* and *Foramen Rotundum;* but in the natural state of the parts these deficiencies are closed, and there is no direct communication of the tympanum either with the labyrinth or the meatus auditorius externus. The only direct communications being those above mentioned, with the fauces and the mastoid cells.

That deficiency in the bone between the tympa-

num and the labyrinth, which is called *Foramen Ovale*, is closed by one of the small bones of the ear, called the *Stapes*. The other deficiency, called *Foramen Rotundum*, is covered by the membrane which lines the tympanum.

In the cavity of the tympanum are four of the smallest bones of the body, which are articulated with each other so as to form one flexible piece.—This piece is attached by one end to the *membrana tympani*, and the other to the *Foramen Ovale;* and it is moved by small muscles connected with it.

The cavity of the tympanum is lined by a membrane which has been considered as similar to the periosteum: but it is asserted by Bichat that this membrane, when inflamed, resembles the mucous membranes; and that in its natural state it secretes a mucus which passes into the fauces by the Eustachian tube.

This lining membrane is continued over the internal surface of the membrana tympani, and was supposed by the aforesaid author to be reflected so as to cover the small bones of the ear.

The opinion of Bichat, respecting the nature of the membrane, is rendered probable by analogical reasoning, viz. The internal surface of the cavity must be in want of mucus or cuticle, as it is in contact with the air. The membrane is very sensible in a sound state, and therefore is very different from periosteum, which it was supposed to resemble.

The Membrana Tympani,

Appears to be fixed in a bony ring in the meatus auditorius, and is nearly circular in form. It is not perpendicular to the meatus, but has an oblique position in it; the inferior margin projecting further inwards than the superior.

The external surface forms a conical concavity,

being apparently drawn in by the malleus, one of the small bones of the ear, to which it is attached.

It is asserted by several anatomists, that this membrane may be separated into four lamina, viz. 1. The *Cuticle;* and 2. The *Cutis;* which are continued from the skin of the meatus externus. 3. The proper *Membrana Tympani;* and 4. The *Lining Membrana of the Tympanum;* which is extended over the internal surface of the membrana tympani. Notwithstanding these lamina, it is almost transparent in the *living subject*, when in a healthy state, and appears highly polished on its external surface, when light is thrown upon it. It has been injected so as to appear vascular in every part; and one or two vessels are sometimes seen even in common injected preparations. In some cases of inflammation it has been uniformly red.

It was formerly asserted by Rivinus, a professor at Leipsic, that there was a natural aperture in this membrane; but although this opinion has had several votaries, it is certainly erroneous. At the same time it is to be observed, than an aperture, occasioned by accident or disease, is sometimes perceived in persons who enjoy the faculty of hearing to a considerable degree. Some persons, thus circumstanced, are accustomed to force tobacco smoke from the mouth through the ears.

It is asserted by a respectable anatomist * that the membrana tympani, when viewed in a microscope, which will magnify twenty-three times, appears to be supplied with muscular fibres arranged in a radiated manner. These fibres are on the internal side of the membrane. He thinks that under favourable circumstances they can be seen with the naked eye.

* See Mr. Home's Memoir on the structure and uses of the membrana Tympani, in the Philosophical Transactions for 1800.

The Eustachian Tube.

The communication between the cavity of the tympanum and the fauces is formed by the *Eustachian Tube*, a canal which consists of bone at one extremity, and of cartilage at the other. It commences in the upper and anterior part of the cavity of the tympanum, and continues forwards and inwards through a part of the petrous portion of the temporal bone, above the fissure in the cavity for receiving the condyle of the lower jaw. The bony canal terminates in a very rough and irregular orifice, which is united to a tube composed of cartilage and of membrane, that terminates by a large orifice behind the inferior turbinated bone of the nose, and on a line with it.

This tube is lined by a continuation of the membrane of the posterior nares, which becomes more thin as it proceeds towards the cavity of the tympanum.

Above the Eustachian Tube, and separated from it by a thin plate of bone, is a small canal which is nearly parallel to it, and continues so to the end of the petrous bone; this contains the internal muscle of the malleus.

The Mastoid Cells.

In the upper and back part of the cavity of the tympanum, nearly opposite to the orifice of the Eustachian Tube, is an opening which communicates with the cells of the mastoid process. These cells do not appear different from those in other bones, and are lined with a membrane apparently similar. Their size is proportioned to that of the mastoid process, and consequently they do not exist in the fœtus.

Foramina and Protuberances of the Tympanum.

That part of the surface of the cavity of the tympanum which is opposite to the membrana tympani.

is very irregular, but it contributes to the formation of several parts which are very important in the structure of the ear.

When the lining membrane is removed, the aperture called *Foramen Ovale,* appears in a conspicuous situation, rather above the middle of this surface. It would open directly into the *Vestibule,* or middle chamber of the *Labyrinth;* but it is closed by the base of the stapes.

Above the foramen ovale is a prominence of the surface, in which passes the canal for the *Portio Dura* of the seventh pair of nerves.

Under the above mentioned foramen is a more striking protuberance called the *Promontory;* within which is a part of the *Cochlea,* the anterior division of the *Labyrinth.*

At the under and posterior part of the promontory is the *Foramen Rotundum,* which opens into the *Cochlea.* This foramen is smaller than the foramen ovale; and in its recent state is covered by the membrane which lines the tympanum.

Behind the foramen ovale is a protuberance with a perforation in it. This is called the *Pyramid.* It is excavated, and contains the muscle of the stapes, which passes out through the perforation.

The Bones of the Ear.

The four small bones in the cavity of the tympanum are denominated *Malleus, Incus, Orbiculare,* and *Stapes.*

The *Malleus* resembles a crooked club more than any of the hammers now in use. It consists of an irregular roundish head, a neck, and a long tapering body, called the *Manubrium* or *handle.* It has also two processes; one arising from the neck which is long and slender, like a bony fibre, and therefore called *Gracilis.* The other called *Brevis* arises

from the upper end of the handle. The handle of the Malleus forms an angle with its body, the salient side of the angle presenting outwards: the space from this angle to the termination of the manubrium, or in other words the whole manubrium is connected with the membrana tympani.

The *Incus* resembles a *molar tooth*, with two roots, widely separated from each other. On the body is a depression which is connected with the head of the malleus. One of the roots or crura is much longer than the other.

The *Os Orbiculare* is equal in size to a small grain of sand. It is connected to the extremity of the long crus of the incus, and to the upper part of the stapes.

The *Stapes* has a strong resemblance to the common stirrup. The upper part is called its *head*, the lower part its *base*, and the two lateral portions its *crura*. One of the crura is longer than the other. A groove is also observed on the inner side of its crura, when they are examined with a microscope. The base is applied to the *Foramen Ovale*.

The situation of these bones is such, that the head of the malleus and the body of the incus are in the upper and anterior part of the cavity of the tympanum, which extends above the membrana tympani. The malleus is the most anterior of the two bones: its manubrium projects downwards, and is included between the internal lamen of the membrana tympani and the membrane itself. Its long process extends horizontally, inwards and forwards, into the fissure of the glenoid cavity.

The incus is so placed that the depression on its body receives the head of the malleus. The shortest leg projects backwards horizontally, and is attached by a ligament to a point in the opening into the

mastoid cells. While the long leg projects downwards like the handle of the malleus, but behind it, and at a small distance inwards from the membrana tympani.

The situation of the stapes is almost at right angles with the long leg of the incus, projecting inwards. Between the head of the stapes and the long leg of the incus, the os orbiculare intervenes.

When these bones are viewed in their natural position, the short leg of the incus projects horizontally backwards, the long process of the malleus horizontally forwards; the handle of the malleus, and the long leg of the incus, directly downwards, one connected with the membrana tympani, and the other with the foramen ovale, by the intervention of the os orbiculare and stapes.*

The Muscles of the Bones of the Ear.

The aforesaid bones appear to be regularly articulated for motion with each other, and they are furnished with several muscles.

One of these muscles runs in the bony canal above the Eustachian tube, and is inserted into the posterior side of the handle of the malleus, below the root of the long process. Its effect is to draw in the malleus and membrana tympani. It is therefore called *Tensor Tympani*, or *Iternus Auris*.

Another muscle, as it is supposed to be, runs in

* Lassus in his excellent discourse on Anatomy informs us that Fallopius and Eustachius described nearly the whole interior of the Ear. The most ancient authors had remarked the thin and transparent membrane which closes the extremity of the meatus externus. Fallopius described particularly the tympanum; of the four bones within it, the malleus, incus, os orbiculare and stapes. Berenger de Carpi described the two first; Ingrasias, Eustachius, Columbus, and Louis Collada, a Spanish physician, disputed the discovery of the fourth with each other; and Vesling assures us that Francis de la Boe, a Dutch physician, discovered the third which is the smallest.—Ed.

the fissure on the outside of the Eustachian tube, and is inserted into the long process of the malleus.

This is supposed to draw the malleus obliquely forward, and of course to relax the tympanum. It is therefore called *Laxator Tympani*, or *Externus Mallie*; but there are the strongest doubts respecting the muscularity of this organ.

Morgagni, Haller, Lieutaud, and Meckel, could not satisfy themselves that it was muscular; and Sabatier also doubts of it; while Bell, Fyfe, Hume, Bichat and Gavard, appear to adopt the opinion of its muscularity.

Some anatomists describe a third muscle of the malleus as arising from the superior posterior margin of the meatus auditorius, where the membrana tympani adheres to it, and uniting to the neck of the malleus. It is supposed to draw the malleus and membrana tympani upwards and forwards. This however is noticed by few authors.

The stapes is also supplied with one muscle called the *Stapedius*, which lies in the cavity of the pyramid. Its tendon passes through the foramen in that protuberance, and is inserted into the posterior part of the head of the stapes. It pulls the head of the stapes upwards and backwards.

The Chorda Tympani.

In the upper and posterior part of the cavity of the tympanum is a small nervous cord which enters by a foramen near the basis of the pyramid, and passing downwards and forwards, goes out at an aperture in the fissure of the cavity for the head of the lower jaw. In this course it crosses the long leg of the incus, and the manubrium of the malleus, and passes between them, being in contact with the manubrium.

This nerve comes off from the portio dura immediately before it emerges from the foramen stylomastoideum, and after passing a short distance through a small canal, enters the cavity of the tympanum as above described. After passing out of the cavity of the tympanum it joins the lingual branch of the fifth pair of nerves.

It was believed by the late Mr. John Hunter that the chorda tympani is not simply a branch of the portio dura, but that it is the twig of the reflected branch of the spheno palatine nerve, which entering the os petrosum by the *Vidian Foramen* joins the portio dura; and after passing with it a considerable distance, leaves it at the place above described.*

There is the greatest reason to believe that the principal object of the structure above described, is to transmit to the labyrinth those impulses of the air which occasion sound. The membrana tympani, with the small bones and their muscular appendages, seem to be the agents for this purpose. The Eustachian tube, and the mastoid cells, are subservient parts. The effect of the chorda tympani in the cavity, has not been ascertained.

With this view of the subject it is surprising that persons in whom the membrana tympani has been destroyed, should enjoy the sense of hearing in a very considerable degree of perfection. Such, however, is the fact.

It is necessary that there should be a communication between the cavity of the tympanum and the external air, in order that the function may be duly performed.

This is evinced by the deafness which results from the obstruction of the Eustachian tube, and the cure of this deafness by relieving that obstruction; as well as by the salutary effects of opening the membrana tympani;† and even of instituting a communication through

* I have followed Mr. H. in this dissection and have no doubt of his opinion being correct.—Ed.

† See Dr. Sim's paper on this subject in the first volume of Memoirs of the Medical Society of London; and Astley Cooper's in the London Philosophical Transactions.

the mastoid cells, in cases where the obstruction of the Eustachian could not be removed.

It has been supposed that the Eustachian tube has the effect of transmitting sound to the ear, and particularly the voice of the individual of whose structure it is a part: and it is certain that we hear our voices very distinctly, (although peculiarly modified,) when the external orifice of the ears are closed: but the well known fact that a small watch, when placed in the mouth, and not in contact with any part of it, is scarcely heard, if heard at all, renders this opinion very doubtful. It ought, however, to be remembered, during the investigation of this subject, that persons who hear with difficulty are almost invariably in the habit of opening their mouths when they listen.

SECTION III.

Of the Labyrinth.

Those parts of the organ of hearing which have been already described, seem calculated for concentrating the vibrations of air; and for communicating, with some modification, the motion they occasion, to the *Labyrinth.*

This important portion of the ear consists of *three very dissimilar parts,* which communicate with each other and form one *general* cavity.

The central part of this cavity is a chamber of a form which approaches to the oval, and has been compared to that of a grain of barley. It is called the *Vestibule.*

At one extremity of this chamber are three tubes, each of which is curved so as to form a large portion of a circle. These tubes communicate with the vestibule by each extremity; but they form only five orifices, because two of their extremities are united

before they open into the vestibule. These tubes are denominated the *Semicircular Canals.*

At the other extremity of the vestibule is a conical tube convoluted like the shell of a snail. This is called the *Cochlea.* It also communicates with the vestibule.

The Labyrinth, thus complicated in its form, is situated on the inner side of the cavity of the tympanum. Its position is such that the *Vestibule* and the *Cochlea* are opposite to the *Membrana Tympani,* and the *Semicircular Canals* are posterior to it. The apex of the cochlea is on the side of the labyrinth which is next to the tympanum, the basis of the cochlea is next to the brain.

The texture of the bone which immediately surrounds these cavities is much harder than that of the other parts of the os petrosum ; and if the bone of a fœtus be used, these softer parts may be cut away so as to leave behind the bony substance which surrounds these cavities, corresponding exactly to their form.

The *Labyrinth,* when thus prepared, may be considered as a solid body which has been enveloped in a softer substance, and is brought into view by detaching the soft substance, which surrounded it.

In the fœtus it is nearly as large as in the adult, so that the structure of the ear can be investigated with great advantage in such subjects.

The Vestibule

Is situated within the *Foramen Ovale.* There are two remarkable depressions of its internal surface ; one, which is in the superior part, is called *Semi Elliptical ;* the other, which is below, has the name of *Hemispherical.*

When the dried preparation is examined there are several foramina in this cavity, viz. The *Foramen*

Ovale, already mentioned. A *round aperture*, by which it communicates with one of the cavities of the cochlea, and the five openings of the semicircular canals. Besides these, there are several small perforations from the *Meatus Auditorius Internus* for the transmission of nerves.

The Cochlea.

Commences at the anterior part of the vestibule. It is a conical tube, so convoluted that it has the form of the shell of a snail, making two circuits and a half round a centre.

It may be considered as wound in a spiral direction round a pillar of bone. To this central pillar the name of *Modiolus* is applied. It commences at the cavity called *Meatus Auditorius Internus;* and its base is somewhat excavated. It gradually diminishes in diameter as it proceeds towards the apex of the cochlea, and is therefore conical in form; but it does not preserve this form to its termination, for near the apex it gradually becomes broader, and thus forms a second cone inverted. This last portion of the central pillar is called the *Infundibulum.* It is hollow; and the portion of bone which covers its cavity, constitutes the basis of the inverted cone and the apex of the cochlea. It is called the *Cupola.*

The tube thus wound round the modiolus, or the cochlea, is divided from the beginning to the end by a partition.

The cavities are called *Scalæ*, and the partition *Lamina Spiralis.*

The *Lamina Spiralis* is made up of four parallel strips, which compose its breadth.

1st. A plate of bone.

2d. Outside of this, a softer plate, which appears cartilaginous.

3d. A cellular portion, which appears to contain a pellucid fluid.

4th. A thin membranous strip, which completes the septum or partition.

These parts may be distinguished from each other, when magnifying glasses of sufficient power are used.

The bony plate is composed of two lamina with small cancelli between them, in which are canals for the transmission of the fibres of nerves. These canals are extended into the cartilaginous part.

The membranous part which completes the septum is continued into the lining membrane on the surface of the cochlea.

The bony portion of the scala does not extend towards the apex of the cochlea so far as the cartilaginous and membranous portions; and none of them continue to the apex, for the lamina spiralis terminates in the infundibulum before it has arrived at the apex. Its extremity has the form of a hook, and is therefore termed *Hamulus.*

As this septum does not extend to the apex of the cochlea, the two scalæ necessarily communicate with each other at the apex.

These different bands or strips which compose the lamina spiralis, are called its *Zones*, and are termed *Zona Ossea*, *Zona Coriacea*, *Zona Vesicularis*, and *Zona Membranacea.*

From what has been stated it follows that there are two cavities in the cochlea, each of which continues throughout its whole extent. One begins at the vestibule; the other at the tympanum. But a membrane extended over the foramen rotundum separates this last from the tympanum. They communicate with each other at their terminations. From their origins they are denominated *Scala Vestibuli* and *Scala Tympani.*

As both the cochlea and the vestibule are filled with a fluid, it is evident that a vibration produced on the membrane of the foramen rotundum may be communicated through the two scalæ to the vestibule.

The three Semicircular Canals

Are placed obliquely behind the vestibule. Their position is such that one is *Superior*, another *Posterior*, and the third *Exterior*. The superior and posterior are so placed that one extremity of each may be considered as internal and the other external. They unite at their internal extremities, which therefore form but one orifice in the vestibule. Their other extremities, being separated to a considerable distance, form each one orifice. While the external canal, which is smaller than the others, opens by two orifices.

Each of these canals is nearly of the same diameter, viz. rather more than two lines.

At one of their extremities each of them has an enlargement, which is called *Ampulla;* and there is no other variation of their diameters.

The cavity of the labyrinth, thus complicated, is perforated by many small foramina, through which various nerves are transmitted.

These foramina communicate with the large canal on the posterior side of the petrous bone called *Meatus Auditorius Internus:* which continues very near to the basis of the cochlea, and transmits the seventh pair of nerves.

The bottom of this cavity is divided by a ridge into two unequal fossæ; the uppermost of which is the least.

In the *Upper fossa* are two foramina: the anterior, which is the largest, serves to transmit the *Portio dura*, a part of the seventh pair, to be hereafter des-

cribed, which passes through the petrous bone to the face. The posterior foramen forms a pit with a cribriform bottom, which admits nervous fibrillæ to the vestibule.

The anterior part of the *Inferior Fossa* is also cribriform; its perforations lead to the cochlea; one of them, which passes through the modiolus to the infundibulum, is larger than the rest. The posterior part of this fossa is occupied by foramina, which pass to the vestibule and semicircular canals; but they are not so numerous as those which lead to the cochlea.

Contents of the Labyrinth.

This interesting cavity is lined throughout by a delicate membrane. It contains sacs and tubes, and a plexus of delicate nerves, which constitute a soft labyrinth within that which is composed of bone.

In the cavity of the *Vestibule* are two sacs distinct from each other, and also from the lining membrane.

One of these, denominated *Sacculus Sphericus*, or *Sacculus Vestibuli*, is situated partly in the *Hemispherical Cavity* of the vestibule, and has no direct communication with any other part.

It contains a limpid fluid, and is said to have so much firmness, that when opened with the point of a lancet it will retain its form.

The other sac is situated partly in the depression called *Semi-elliptical*, nearly opposite to the foramen ovale: it is so transparent that it is sometimes seen with difficulty, and appears like a bubble of air in a fluid. All the membranous semicircular canals, which are soon to be described, communicate with it by each of their extremities: it has been called *Alveus Communis* by Scarpa, and *Utriculus* by Soemmering.

In the bony canals already described, are *three*

Membranous Semicircular Canals, which resemble them in form. They have an ampulla at one extremity, as they arise from the sac above mentioned, and are cylindrical during the remainder of their course; they are transparent, and have smaller diameters than the bony canals, although they are rather longer.

The Auditory Nerve.

Upon this structure, viz. *the Sacs in the Vestibule, the Membranous Tubes in the Semicircular Canals*, and *the Lamina Spiralis of the Cochlea*, are expanded the fibres of the *Auditory Nerve.*

This nerve, with the *Portio Dura*, and its appendage, the *Portio Media*, composes the seventh pair of nerves of the brain.

It is called *Portio Mollis*, and is very distinct from the *Portio Dura*, although they pass together along the *Meatus Auditorius Internus.*

Corresponding to the foramina and the cribriform structure of the bottom of the Meatus Auditorius Internus, the *Auditory Nerve* passes into the Labyrinth in branches, or fibrillæ, of various sizes. One portion of them enters the Vestibule, and has been traced upon the Alveus or Utriculus, and its internal surface; and also upon the Semicircular membranous tubes. Another portion seems exclusively appropriated to a part of these tubes. And a third is spent upon the Sacculus Sphericus.

These nervous fibres seem to terminate in a pulpy expansion on the internal surface of the aforesaid sacs and canals, in a way which has some analogy with the termination of the optic nerve.

A large bundle of these fibrillæ enters the Cochlea at its base; and the largest of them passes through a foramen, mentioned before, along the centre of the Modiolus to the Infundibulum.

These fibrillæ divide most minutely, and passing between the plates of the *Lamina Spiralis*, as well as the other parts of the bony structure of the Cochlea, at length form a plexus, which has the appearance of a pulpy membrane, that is extended over the whole of the Lamina Spiralis. Thus is the Auditory Nerve distributed.

To complete the account of the labyrinth, it is to be observed that a pellucid fluid certainly exists in it; exterior to the sacs in the Vestibule, and to the Membranous Semicircular Canals. So that the Membranous Labyrinth may be said to be immersed in a fluid.

This fluid fills also the Cochlea.

The Aqueducts.

It is probably on account of this fluid, that two small canals exist; which are called, after the anatomist who first suggested their use, the *Aqueducts of Cotunnius.**

One of these commences in the Scala Tympani of the Cochlea, near the foramen ovale; and terminates in the jugular fossa, by a small orifice, situated before the spine that separates the eighth pair of nerves from the internal jugular vein. It is called the *Aqueduct of the Cochlea.*

The other originates in the vestibule, under the common orifice of the two canals; and terminates on the posterior surface of the petrous bone, by a small orifice, which is situated at some distance behind the Meatus Auditorius Internus. It is called the *Aqueduct of the Vestibule.*

To this account of the ear it ought to be added, that the *Portio Dura*, after entering into the petrous bone by the foramen in the upper fossa of the Mea-

* See Sandifort's Thesaurus Dissertationum, &c. vol. 1.

tus Auditorius Internus, proceeds in a canal which is called the *Aqueduct of Fallopius*, through the bone, to the Foramen Stylo Mastoideum, on its inferior surface; where it emerges, and is distributed to the face. It is therefore called the *Fascial Nerve* by some anatomists.

In the course of this nerve from the Meatus through the solid bone, it forms a remarkable angle, and then passes between the Cochlea and the Semicircular Canals, to the foramen Stylo Mastoideum.

In this course it soon receives the Vidian Nerve already mentioned; and it sends off the Chorda Tympani, immediately before it passes out at the Foramen Stylo Mastoideum. It also sends off small fibrils to the muscles of the bones of the ear.

It has not been ascertained whether the Portio Dura, the Vidian Nerve, and the Chorda Tympani, have any effect upon the function of hearing.

The situation of those branches of the Auditory Nerve which are expanded in the Vestibule and the Semicircular Canals, is somewhat different from the situation of those which are in the Cochlea; but it has not yet been ascertained how far their functions are different.

The information on this subject derived from comparative anatomy, is very interesting; but for want of more acquaintance with the state of this function in the different animals, no very decisive inferences have been drawn from it.

The Vestibule and Semicircular Canals occur much more frequently than the Cochlea, which is to be found in few animals, if any, besides those of the classes of Mammalia and of Birds. It is therefore supposed necessary to that perfect state of hearing which the animals of these classes enjoy. But there remains a considerable difficulty on this subject; the Cochlea is not by any means so perfect in birds as in quadrupeds; yet many birds appear to have clear perceptions of musical sounds, and some birds imitate articulate sounds with considerable accuracy.

That the impression which produces hearing is made on

the nervous expansions in the Labyrinth, does not appear to be doubted by any one. The structure of the whole organ, and the analogy between it and the eye, induce a strong belief that this is the case.

This belief is confirmed by a dissection recorded by Mr. Haighton,* in which *Original Deafness* was found to depend upon a quantity of cheese-like matter, which filled the whole Labyrinth, and was attended with a considerable diminution of the size of the Auditory Nerve: while all the other parts of the organ were in a perfectly natural state.

* See Memoirs of the Medical Society of London, vol. 3.

SYSTEM OF ANATOMY.

PART V.

OF THE GENERAL INTEGUMENTS: OR THE CELLULAR MEMBRANE AND THE SKIN.

CHAPTER I.

OF THE CELLULAR MEMBRANE.

THAT substance which is situated between the skin and the muscles, which is insinuated between the different muscles, and between the fibres which compose them; which also connects the different parts of the body to each other, is denominated the *Cellular Membrane*, or *Tela Cellulosa.*

As it extends over the whole of the body, and is most intimately connected with the skin, it is considered as one of the integuments, although it is found in great quantities in some of the internal parts.

It appears to be composed of membranous lamina, exquisitely fine and delicate in their structure, which are so connected to each other that they compose cells or cavities of various forms and sizes.

When these cavities are empty, this arrangement of the cellular membrane is not appárent; but when they are distended by water or air it is very evident.

The lamina which pass from one contiguous part to another are of different lengths, according to the motions performed by the different parts; thus, about the muscles and their tendons they are of considera-

ble length, and between the coats of the eye they are very short.

In some places these lamina are compressed together, and form a dense membrane somewhat resembling tendon; but whenever they are separated from each other they appear pellucid, and extremely delicate.

These laminæ, when in a healthy state, appear to have no sensibility; but so many nerves pass through them, that pain is generally felt when incisions are made in the cellular membrane.

No vessels can be seen in their composition when they are free from disease, although many pass through them. On this account they have been considered by some very respectable physiologists as inorganie; but there are good reasons for regarding this sentiment as erroneous.

If a portion of cellular membrane, in the living subject, be brought into view by a surgical operation or a wound, and be allowed to remain sometime, covered by an emollient cataplasm, or a soft plaster, a eomplete change of colour will gradually take place; it will become uniformly red, in consequence of the great number of minute vessels into which blood has penetrated during inflammation; and granulations will form on its surfaee.

These vessels must have existed previously in the sound state of the membrane, and conveyed a transparent fluid; although no structure of this kind was visible. This single fact therefore proves completely its organization.

In some parts of the body, this cellular membrane appears to be moistened by a small quantity of fluid, or halitus, in its cells; which seems merely sufficient to keep it soft and flexible. In other places it is loaded with fat.

There is great reason to believe that the fat is

contained in cavities which are somewhat different from the ordinary cavities of the cellular membrane.

The cells or cavities which contain the moisture or halitus communicate with each other, over the whole body. Thus, air insinuated into the cellular membrane exterior to the pleura, in consequence of a fractured rib, will be diffused over the whole body; and produce the disease called *emphysema.* In a patient who is affected with that species of dropsy called *anasarca,* a portion of the fluid will be effused in the head and upper parts of the body, after he has passed a night in bed in a horizontal position; but after he has been in an erect position for some time, the fluid will be accumulated in the legs and feet, or most depending parts of the body, in consequence of its gravity.

It is well known in dissecting rooms, that the effused water may be completely discharged from anasarcous subjects, by making incisions in the feet, and placing the subject erect.

Blood effused in the cellular membrane is sometimes dispersed in the same way; an ecchymosis often appears in the eye-lids in consequence of a contusion on the upper part of the head; and similar appearances occur in almost every part of the body, in consequence of effusions of blood at a distance from them.

The fat or adipose matter is not diffused in this manner: wherever it is first effused, it remains; uninfluenced by gravity, or the ordinary pressure.

Fat is not observed in every part of the body; it is never seen in the cellular membrane of the eyelids; of the penis; of the lungs; or of the parts within the cranium; as well as of several other places. The inconvenience which would result from the accumulation of fat in these places is very obvious: and it is equally certain that the cellular membrane, in

them, must be different from that in which fat is produced.

From these peculiar circumstances, relative to the adeps, it has been inferred, that there was a peculiar apparatus for the production and retention of fat, superadded to the cellular membrane; and some anatomists, with a view to precision, have called the part containing fat, *Adipose Membrane*, and the other part *Reticulàr Membrane*.* They state that in dropsical subjects, who are much emaciated, the membrane, which in a healthy state contained adeps, is more ligamentous than the ordinary cellular membrane.

It seems to be proved, by reasoning, that there must be a considerable difference between these different parts of the cellular membrane; but it ought to be observed that those parts of the omentum which are especially appropriated to the production of adeps, do not exhibit any peculiarity of structure.

This adipose substance is distributed in unequal proportions in different parts of the body. In corpulent persons there is a considerable quantity of it, immediately under the skin, and especially under the skin of the abdomen.

It is also between the muscles, in the orbits of the eyes; in the omentum and mesentery; in the joints and the bones; as well as about the kidneys, and the heart also, in elderly persons. In the fœtus, and for some time after birth, it appears to be confined to the parts immediately under the skin, but it soon becomes more diffused.

It is observed by dissectors that there are no subjects, however emaciated, which are entirely free from fat; except those which have been affected with anasarca.

* See remarks on the cellular membrane, &c. by Dr. W. Hunter, in the London Medical Observations and Inquiries, vol II.

The cellular membrane has been already observed to form granulations very promptly; and it has been asserted that the granulations, which arise from all the different parts of the body, when wounded, originate from the cellular membrane in those parts.

Whether this proposition be true or not, to the extent above stated, it is a fact that granulations, in some instances, seem to have a cellular structure; as the following case will prove.

A patient with a compound fracture of the leg, which was attended with a large wound, covered with luxuriant granulations, was attacked with an œdematous swelling of the limb, which increased suddenly to a great degree. While this was going on, the granulations on the surface of the wound tumified with the limb; and upon examination, appeared somewhat pellucid with an effused fluid indenting by pressure, precisely as the skin was indented.

The cellular membrane appears to have a most intimate connexion with the skin; and cannot be completely separated from it by dissection. It is said that in certain cases of disease, where it is reduced to a slough, while the texture of the skin remains unchanged, as in some species of anthrax or carbuncle, this separation may be completely effected. In such cases the under surface of the skin will appear to be composed of pits or excavations, which penetrate very deep into its substance, and were occupied by the cellular or adipose membrane while it was in its natural condition.

CHAPTER II.

OF THE SKIN.

The skin is composed of three dissimilar lamina, which are denominated the *Cutis Vera*, the *Rete Mucosum*, and the *Cuticula*.

SECTION I.

Of the Cutis Vera.

The innermost of the above mentioned lamina is much more substantial than the others, and therefore is called *Cutis Vera*.

It is an elastic, dense, and strong membrane; which contains in its texture a large proportion of fibres that appear to be tendinous, and are woven together in an intricate manner.

Blended with these fibres is an immense number of vessels which enter into the texture of the skin: these vessels do not generally convey red blood, and therefore they are not very visible; yet they may be readily brought into view, by the application of rubefacients during life; and by fine injections, in the dead subject. Their existence is also demonstrated in the vigorous infant, at birth, by the universal redness of the skin, which is observable at that time.

Nerves are also distributed to every part of the skin. They can be traced to it very easily; and as there is no part of the skin, into which the finest needle can be pushed without pain, it is certain that their distribution must extend to every part.

It is highly probable that the processes of absorption and exhalation are effected by small vessels

which originate or terminate on the surface of the skin, and of course form a part of its texture.

The skin, thus constructed, extends over the whole of the body, and is continued into those cavities which open upon the surface, as the mouth, nose, &c. although its texture changes immediately upon its reflexion.

It varies in thickness in different parts; thus, it is thicker on the back than the front of the body. It is thin on the insides of the arms and leg, where opposite surfaces touch each other.

It is in general thinner in women than in men.

The elasticity of the skin is made evident by its yielding to distention, and returning to its usual size; as in pregnancy, dropsy, &c. but it is particularly demonstrated in some cases of parturition, when the skin of the perinæum stretches immensely, and, after labour, very quickly recovers size.

The external surface of the skin is very generally divided by superficial grooves or sulci, into small spaces of various angular forms; most commonly rhomboidal. On the palms of the hands and soles of the feet, instead of these figures, we perceive the whole surface composed of furrows and ridges, which in some places are rectilineal and in others oval and spiral.

There are also a number of depressions or grooves which seem formed to accommodate the various articulations, particularly about the fingers and toes.

There are other furrows, occasioned by muscles, as those on the forehead; and some depend on the subjacent cellular membrane.

On the external surface of the true skin, when the two exterior lamina are removed; many papillæ are to be seen. They differ in size in different parts of the body: they are vascular, and, on the ends of the

fingers, appear like villi, when examined by a magnifying glass.

There are many perforations or pores to be seen on the skin with the naked eye, which are probably the ducts of sebaceous glands, and the passages which transmit hairs. Other pores, different from either of these, are to be seen when magnifying glasses are used ; as those on the fingers : these probably are the exhaling or absorbing pores, but their connexion with the vessels which perform these functions has not yet been demonstrated.

The internal surface of the skin, when carefully dissected from the subjacent cellular membrane, in a subject of ordinary corpulency, appears to have some adipose substance in its texture ; but, as has been already mentioned, when the cellular membrane is destroyed, these portions of adipose matter disappear, and the surface of the skin appears pitted. It is probable that this connexion of the cellular membrane and skin may occasion that delicacy of skin which appears some in hydropic patients.

In some places on the under surface of the skin are small glands called *miliary*, from their resemblance to the millet seed ; these glands are supposed to secrete a sebaceous matter, but they are not so general as has been supposed.

There are sebaceous follicles or ducts which open on the external surface of the skin, and contain an oily substance, which sometimes has the consistence of suet or tallow : when these ducts are filled with sebaceous matter, their orifices are often covered by a black substance, which accidently adheres to the surface of the matter, and forms very small black spots in the skin. These often occur on the nose and ears, and may be removed by pressing out the sebaceous substance, which rises up in the form of small worms. Sometimes this secretion accumulates

in the ducts in such quantities that it forms small tumours in the skin.

Muscular fibres have been supposed by some persons to exist in the skin, but such fibres have never been demonstrated in it. The skin of the scrotum is often much contracted, but the fibres which produce this effect are very visible in the cellular membrane, and have a muscular appearance.

Although the skin is not muscular, it sometimes changes its appearance in a surprising manner.

When the surface of the body is suddenly exposed to cold, or when the chill of fever exists to a considerable degree, the skin will contract very sensibly; and at the same time a great number of conical papillæ will project from its surface. This constitutes the *Cutis Anserina ;* and is supposed to be produced by a sudden contraction of the vessels in the skin, which forces out their contents, and of course diminishes its bulk ; while the papillæ do not contract in the same degree, and therefore are somewhat projected.

When the skin is free from disease, the two exterior lamina may be separated from it completely, after maceration or putrefaction, and the surface will appear smooth ; but in an inflamed skin, a net-work of vessels has been injected ; which is considered by Mr. Cruikshank* as an additional lamen. In this lamen the pustules of small pox originate. When the skin is injected they appear to be formed at first by very small vessels, arranged in a radiated manner, with a white uninjected substance in the centre, which is supposed to be a slough, occasioned by the irritation of the variolous matter. Mr. Cruikshank after removing this lamella was able, by continued

* See Experiments on Insensible Perspiration, &c. by W. Cruikshank.

maceration of the same skin, to separate another, which was also vascular. It is to be observed that this skin had been preserved for some time in spirits, and was macerated in putrid water a week during the heat of summer, before the first lamella was removed.

The colour of the healthy skin is invariably white, when all the lamellæ exterior to it are removed. This is the case not only with the European, but with the blackest African, and the people of all the intermediate colours.

The variety of colours in the human species depends upon the lamella next to the cutis, which is now to be described.

SECTION II.

Of the Rete Mucosum.

IMMEDIATELY in contact with the external surface of the cutis vera is a thin stratum, of a pulpy or mucilaginous consistence, which appears to be spread uniformly over it, but cannot be detached without deranging its own texture.*

It can be best examined after the cuticle is raised in a blister. In this case it appears like a pulpy substance, spread upon a membrane of a soft and delicate texture. This is the *Rete*, or *Corpus Mucosum.*

In this pulpy substance resides the pigmentum, or colouring matter, which gives the peculiar complexion to the different races of men. The cutis vera is white, and the cuticle is nearly transparent in them all; but this substance is black in the negro; copper-coloured, yellow, or tawny, in many of

* It has been asserted that the rete mucosum of the scrotum, can sometimes be exhibited in a separate state.

the Asiatics; and yellow, with a tincture of red, in the aborigines of America; while it is transparent, or whitish, in the people of Europe and their descendants.

It can therefore be best examined in the negroes; and if it be inspected immediately after the cuticle of a blister is removed, it will appear as above described, with a black matter diffused through it.

The particular structure of this substance has not been ascertained; although anatomists have paid a good deal of attention to it. It is generally believed by them that no vessels can be injected in it; but Dr. Baynham of Virginia, while he was engaged in anatomical pursuits in London, made a preparation which excited the attention of the British anatomists, on account of its particular relation to this subject.

He injected one of the lower extremities, the *os femoris* of which was diseased with an exostosis; and with a view to an examination of the lamina of the skin, he removed a portion of it from the leg; and after immersing it a few seconds in boiling water, to thicken the lamina, he macerated it in cold water for some days. Upon separating the cuticle, after this treatment, he discovered a texture of vessels on the surface of the cutis vera, which was distinct from the cutis itself. This has often been mentioned as injection of the rete mucosum.

It is to be regreted that Dr. Baynham, who is particularly qualified to decide, has not published his opinion on the subject. Mr. Cruikshank, to whom he afforded the most satisfactory opportunity of examining his preparation, believes that the aforesaid vessels were not a part of the rete mucosum; but that the rete mucosum was to be seen on the epidermis, (being raised with it when it was separated from the cutis,) while this texture remained on the surface of the cutis. He considers these vessels

as belonging to the additional lamellæ already mentioned, of which he says Dr. Baynham is the discoverer.

There is therefore every reason to believe that there is a texture of vessels, either in the rete mucosum, or between the cutis vera and the rete mucosum.

After putrefaction, or maceration for a long time, the cuticle separates readily from the cutis vera; and the rete mucosum sometimes adheres to the skin, and sometimes to the cuticle. If the parts are much softened by putrefaction, the rete mucosum can be washed away, like the pigmentum nigrum of the eye; leaving the cutis white, and the cuticle nearly transparent.

In the negroes the black colour of the rete mucosum is greatly diminished, on the palms of the hands, and soles of the feet, and under the nails: but it is perceptible. It is said that the black colour does not appear in the cicatrices of the blacks. This is the fact with respect to recent cicatrices; but those of long standing are often dark coloured, although not so black as the original skin. The pits of the small pox in their skins, although white at first, become finally as dark as the original surface.

In Europeans and their descendants the colour of the rete mucosum becomes darker, as they are more exposed to the air and the rays of the sun; and soon changes again to its original fairness, by confinement to the house.

In negroes the skin loses some of its deep glossy black colour during the winter season of cold climates; and recovers it again in summer.

The rete mucosum sometimes undergoes very important changes; there have been several instances in the United States, where large portions of the skin of the African have changed from black to

white; owing probably to an absorption of the black pigment from the rete mucosum; or perhaps to an absorption of the rete mucosum itself.

There is now in Philadelphia a female, between thirty and forty years of age, in whom this process is going on. One of her parents was a negro and the other a mulatto; and her original complexion accorded with her origin. But a change of colour began during her childhood, in small spots, which have gradually increased so much, that at this time the whole of her body and limbs are nearly white, with the exception of her hands and feet. A large proportion of her face is also white, and the remainder of it much lighter than it was originally. At this time, some part of her face has an unnatural whiteness; but the skin of her fore-arms appears like that of a European in a perfectly healthy state. This change of colour is attended with no unusual sensation; so that if she did not see the alteration, she would not suspect that her skin was any way different now from what it had originally been. She does not appear sensible that the white parts are more susceptible of irritation from the rays of the sun than they were originally; but they are so much covered by her dress that the experiment has not yet been fairly made.

The first appearance of a change is slight diminution of the dark colour; this change goes on gradually, and then small spots appear, which are perfectly white. They gradually increase, and run into each other, and thus a large white spot is formed.

In a former case, where this process had gone on to a great extent, it is said that the black pigment was again deposited, and the skin resumed its original blackness.

These circumstances in negroes have been consi-

dered as great deviations from the ordinary course of nature, but a process very analogous to it sometimes goes on in persons who are white. Thus, there are some in whom the skin becomes much browner than natural in some parts of the body, particularly on the arms; and in these brown portions, spots are formed which are much more white than the natural colour of the skin.

In such cases there appears to be a deposition of colouring matter in the rete mucosum of the brown places; while the white spots are rendered more white than natural, either by an absorption of the rete mucosum, or by a deposition of whiter matter in it.

The colour of the rete mucosum sometimes undergoes a temporary change in particular places. Thus, at a certain period of pregnancy, a dark circle forms round the nipple.

In some cases, where the peculiar whiteness occurs, the skin becomes very susceptible of irritation from the rays of the sun; so as to be blistered, if exposed to them for a short time; this circumstance renders it probable that the colouring matter in the rete mucosum of the blacks, was originally designed to protect their skins from the very powerful rays of the sun to which they are exposed.

There are some persons to be found, among most of the different races of men, who are born with this peculiar whiteness of the whole skin, which continues during life. In these persons, the hair has a remarkable white colour, and the eyes are without the pigmentum nigrum. They appear to be in a state of imperfection, and are unable to endure the ordinary light of day. They are generally designated by the epithet of *Albinoes.*

The texture which exists between the cutis vera and the epidermis is probably the principal seat of

several important cutaneous diseases; as the Scarlatina Pemphigus, &c.* and from what has been stated, there is good reason to believe that the small-pox, also commences in it. It is therefore much to be wished that its structure was more precisely ascertained.

SECTION III.

The Cuticula or Epidermis,

Has been examined with the greatest care by several of the most successful anatomists; but notwithstanding their labours, the structure of this substance is by no means understood.

It appears to have some resemblance to the matter of the nails, and of horn; but is rather more flexible, even after allowing for the difference of thickness.

In those parts where it is thinnest it is semitransparent.

It is insensible, and no vessels can be seen in it.†

It extends over the whole external surface of the body, except the parts covered by the nails, and is accommodated to the surface of the skin, by forming ridges or furrows, corresponding to it.

It adheres most closely to the cutis; and when

* In severe cases of the scarlatina, at the termination of the disease, large portions of the cuticle are sometimes detached from the cutis, so that several practitioners have seen the whole cuticle of the hand come off like a glove. As the texture of the cutis does not appear to be altered in these cases, and the cuticle is also unchanged, the cause of this separation must exist in the intervening structure which connects them.

† In the early part of the last century, an anatomist of the name of St. Andre exhibited a preparation of the cuticle which appeared to be injected with mercury. Ruysh declared the thing impossible, and invited him to an investigation of the subject. This invitation was not accepted, and the affair has been generally considered as a mistake or an imposition.

abraded by mechanical violence, the surface of the skin appears moistened by effusion.

It is not certain that its mode of union with the skin is perfectly understood; the adhesion of these membranes to each other is as uniform as that of two smooth surfaces glued together, but it is generally said that the cuticle is attached to the cutis by very numerous and fine filaments.

It has often been asserted that these filaments are the exhaling and absorbing vessels, which pass through the cuticle, to and from the skin. This sentiment appears very reasonable, but no vessels that pass in this way can be injected.

There are innumerable processes which pass from the cuticle to the skin. Many of these are the linings of the cavities which contain the roots of the hairs; but they are reported by microscopical observers to be like the fingers of a glove, closed at their extremities.

There are also many processes which contain a sebaceous substance that may be pressed out of them in the form of worms: these are the ducts of sebaceous glands.

Besides these, there is an immense number of whitish filaments which are as fine as the most delicate thread of a spider's web. These filaments can be best seen while the cuticle is separating from the skin of the sole of the foot, as suggested by Dr. William Hunter.* They are supposed to be vascular, but they have never been injected.

When the cuticle is in its natural situation, in union with the skin, there appear to be three species of foramina, or pores, on its external surface: viz. 1. Those formed by the passage of the hairs; and 2. Those which are the orifices of the ducts of the

* See the London Medical Observations and Inquiries, Vol. II

sebaceous glands; each of which has been already mentioned. And 3. Such pores as exist on the ends of the fingers and the inside of the hands.

It is said that these last are very visible, when magnified to twice or thrice their original bulk, and drawings of them have accordingly been made by Dr. Grew * and by Mr. Cruikshank.† Small specks of fluid can be seen with the naked eye, in the same situations, in warm weather, or when the ends of the fingers are made turgid by a ligature. It is probable that they are formed by the accumulation of fluid at these orifices.

The above described pores are situated on the ridges at the ends of the fingers and not in the furrows; and it is probable that similar pores are distributed over the surface of the body.

Notwithstanding the appearance of these foramina, when the cuticle is in its natural situation, several of the most successful investigators of the subject have declared that they could not discover any pores or foramina in the cuticle, when it was separated from the cutis.

The late professor Meckel of Berlin, who was one of this number, was induced to believe that the matter of exhalation, and of absorption, soaked through the cuticle, as the vapour of warm water passes through leather.‡

In support of this doctrine he states, that perspiration goes on through the cuticle on the palm of the hands and soles of the feet when it is very thick; and observes, that if it were transmitted by delicate vessels, the vessels in the feet must be torn by the

* In the Philosophical Transactions, vol. III. Lowthrop's Abridgment.
† See his Experiments on Insensible Perspiration.
‡ See Memoirs of the Royal Academy of Sciences of Berlin, vol. XIII. for 1757

weight of the body, in persons who walk; and those in the hands would experience the same fate, in labourers, who work with heavy hammers, &c.

On the other hand, Mr. Cruikshank, who could likewise find *no* pores in the separated cuticle, contends strenuously for their existence notwithstanding; and explains their non-appearance by the following facts, among others, viz. that no foramen will appear in the separated cuticle although it has been punctured by a needle; and that when the cuticle has been peeled off, from portions of the cutis on which were hairs, which must necessarily have perforated it, no foramina have appeared in it.

M. Bichat took very different ground: he asserted that the pores of the separated cuticle were to be seen distinctly, in large numbers, by looking through it towards the light; he also believed that the course of the exhalent vessels, through the cuticle, might be seen in the same manner; and that they passed obliquely.

That the cuticle is pervious, is proved incontestably by the functions of perspiration and sweating, as well as of absorption; but there are good reasons for believing that the perforations of the cuticle have a peculiar structure; and are not simple foramina.—Thus, when a vesicle is formed by the operation of cantharides or any other process, if the cuticle is not lacerated, it will confine the effused fluid for a considerable time, without any appearance of its escape through these pores.

This fact, which is strongly opposed to the hypothesis of Meckel, is explained by Cruikshank upon the supposition that the pores of the skin are lined by processes of the cuticle, and that when the cuticle is separated from the cutis, these processes go with it, and act like valves in confining the fluid.

Bichat supposes the oblique vessels to produce the

same effect upon analogous principles; and compares their situation to that of the ureters, which pass obliquely between the coats of the bladder.

This peculiar quality of the cuticle, in admitting of perspiration and sweat, and also absorption, while it prevents evaporation from the parts which it encloses, is of immense importance.

If a portion of skin be deprived of cuticle a short time before death, by a blister for example, this portion will in a few days become perfectly dry and hard, like horn; while the other parts of the skin of the subject, covered by the cuticle, retain their moisture and flexibility.

It may therefore be admitted, that the use of the cuticle is to keep the skin soft and flexible, by confining its moisture as well as to defend it. And it is probable that the sebaceous matter is secreted for the purpose of preserving the cuticle in a state of flexibility.

As the cuticle is capable of confining fluid, and resisting the action of chemical agents, it is surprising that epispastics and rubefacients should act through it, upon the skin, with so much certainty as we find they do; and that cantharides should produce vesications, when applied dry.

The thickness of the cuticle on every part of the body is much increased by long continued pressure, forming corns and excrescences of its own nature. By this cause also its is rendered very thick on the palms of the hands and soles of the feet; although it is originally thicker there than in other parts.

It is said that, after long boiling, these thick portions of cuticle may be separated into distinct lamina.

In the living subject, the cuticle, when immersed in warm water, seems to absorb some of that fluid; as is evinced by the hands when they have been long

in that situation; and also by those parts of the skin to which poultices have been applied.

Notwithstanding the uniform adhesion of the cuticle to the cutis, it is observed, in the living subject to be separated, and formed into vesicles, by a variety of causes, viz.

1. Pinching of the skin, or violent mechanical irritation; such as labouring with hard instruments.

2. By the application of cantharides, and certain other substances which produce vesications. Sometimes these substances appear to inflame the skin; but on other occasions the vesication is produced while the skin appears unchanged in colour, and free from inflammation. The process appears different from that of simple inflammation; for certain rubefacients often inflame the skin considerably, without vesicating or blistering it.

3. The boiling heat will very generally produce vesication.

4. Certain diseased processes seem to occasion vesication in a manner which is not well understood, viz. *erysipelas*, *zona* or *shingles*, *pemphigus*, and some other eruptions which have no name. In erysipelas there is an obvious inflammation of the skin; but in some of the other diseases the vesication takes place without the appearance of inflammation.

5. Vesications often appear when there is a tendency to gangrene.

6. They also occur in some cases of simple fracture, where there is considerable injury. In these cases the fluid effused is often tinged with blood.

After death the cuticle is separated from the cutis:

1. By putrefaction; in which case large vesicles are sometimes formed.

2. By long continued maceration.

3. By boiling, and

4. By violent dry heat.

The cuticle appears to be least deranged when it is separated by putrefaction and maceration : in these cases the internal surface corresponds to the surface of the skin ; and the processes which contain the hairs, as well as those which are the ducts of the sebaceous glands, are particularly obvious.

The external surface of the cuticle varies in different places, according to the surface of the skin. In some places it appears scaly at times, and has therefore been supposed to consist entirely of scales ; but in other parts, when examined attentively, it appears like a half transparent concreted substance, with a rough surface.

When the skin has continued dry for a long time, bran-like scales can be rubbed off from it. These are probably composed of the residuum of the secretion deposited on the skin, and of a portion of the external surface of the cuticle. The same substance appears upon the first washing of the skin, after that process has been discontinued for any length of time.

Many speculations have arisen respecting the manner in which the cuticle is originally formed, and reproduced ; but none of these are perfectly satisfactory.

It is also a question whether the cuticle is endued with vitality, or is merely an inanimate unorganized concrete. No decisive arguments have been adduced in favour of its vitality ; and it has already been stated, that neither nerves, nor vessels, can be demonstrated in it.

It appears particularly calculated for protecting the skin which it covers ; for it is insoluble in water, and resists the action of several powerful chemical agents. Thus, it is not affected by immersion for a considerable time in the sulphuric and muriatic acids ; although the nitric acid acts upon it.

It resists for a short time, but is at length dissolved, by the pure fixed alkalies, and by lime.

It is supposed by the chemists to consist of albumen, in a peculiar state of modification.

The Nails.

The roots of the nails appear to originate in a fold of the cutis vera, from the epidermis which lines the fold; but the bodies of the nails adhere firmly to the cutis on which they lie; and appear to cover it, in the place of the cuticle. The papillæ of those parts of the cutis which are covered by the nails are very conspicuous when the nails are removed. It has been supposed that there was no rete mucosum between the nails and cutis; but this opinion is probably erroneous, as the black pigment is perceptible under the nails of some negroes.

The nails can be separated from the cutis by all those processes which separate the cuticle from it. When this is effected, they remain connected with the cuticle, which appears to be continued into them: and on this account, as well as their insensibility, and their resemblance to the horny excrescences of the cuticle, they are considered as appendages of it.

The root is opaque, and appears white. The body is transparent, and in health shows the florid colour of the cutis which it covers; but the colour of this portion of the cutis depends upon the state of the circulation; and becomes livid when the blood is disoxygenated, or when the circulation ceases there; and this colour also appears through the nails.

The nails are unquestionably organized, although their ultimate structure is not known. They appear to be composed of lamellæ: and these lamellæ, of fibres. They grow rapidly, and when they are not pared or worn away, they sometimes acquire an immense size.

As a remarkable instance of this, it is related, that a nail of the great toe was sent from Turin to the academy of sciences at Paris, which measured four inches and a half in length.

The growth seems to take place altogether at the roots.

The nails, when chemically examined, appear to consist of a modification of albumen; and thus resemble cuticle and horn, in their composition.

The Hairs

Originate from bulbs which are situated at the bottom of pores or cavities in the skin. These pores appear to be lined by a production of the cuticle, and the extremities of the bulbs project beyond them into the cellular membrane. In some cases, where the cuticle is separated after putrefaction, it seems that these lining processes of the cuticle come away completely, and bring the hairs and their roots with them; but in other cases, the cuticle separates from the cutis, and leaves the hairs in their natural situation.

When viewed in a microscope, the bulb appears half transparent, and whitish; and of a softer consistence than the hair itself. The extremity of it is remarkably flexible, and sometimes much darker than the rest of the bulb. The hair does not appear to extend completely to the end of the bulb. Neither blood vessels nor nerves have been traced to these bulbs, although it is probable they extend there: for the operation of extracting hair by the roots is generally very painful; and blood sometimes appears in the pore from which the hair is extracted.

The body of the hair appears to be composed of smaller fibres, enclosed in a membrane which often is imperfect at the extremity; in consequence of

which the fibres often separate from each other, or split.

Within the hair is diffused the substance upon which its colour depends : this does not appear to be essential to the structure, as in the advance of life the hair is so generally without it, while its structure continues unchanged ; although it becomes less flexible.

The colour of the hair appears to have some connexion with the colour of the rete mucosum, as it is so generally black when the rete mucosum is dark coloured.

The sudden change of colour in consequence of fright or grief, is a very rare occurrence indeed ; but Bichat relates an instance which came under his observation, in which the hair became perfectly white in one night, in consequence of grief.

The SKIN, constructed as above described, answers a fourfold purpose in the animal economy. It is the organ of touch. It covers and protects the whole structure. It is the outlet for a large proportion of the insensible perspiration, and it performs absorption.

Many facts have been noticed by practitioners of medicine which prove that it has a connexion with the lungs and stomach, which is not yet explained by anatomy.

As one of these, an effect of the urticaria or nettle rash may be mentioned. This eruption sometimes relieves completely the spasmodic croup ; and in other cases, nausea, and vomiting.

Some children, when affected with this species of croup, are relieved by rubbing the skin with harsh woollen cloth.

In some places the urticaria and the affection of respiration are so much regarded as symptoms of the same disease, that the term *hives* is used as the name for each of them.

ALPHABETICAL INDEX TO VOLUME I.